

Ex Libris Edmunda 1755

Dr. BOERHAAVE's
Elements of Chymistry,

FAITHFULLY

A B R I D G ' D

From the late

GENUINE EDITION,

Publiſh'd and Sign'd by himſelf at

L E T D E N.

With all the

CUTS and EXPLANATIONS,

Contain'd in the ORIGINAL.

To which are Added,

Curious and Useful N O T E S,

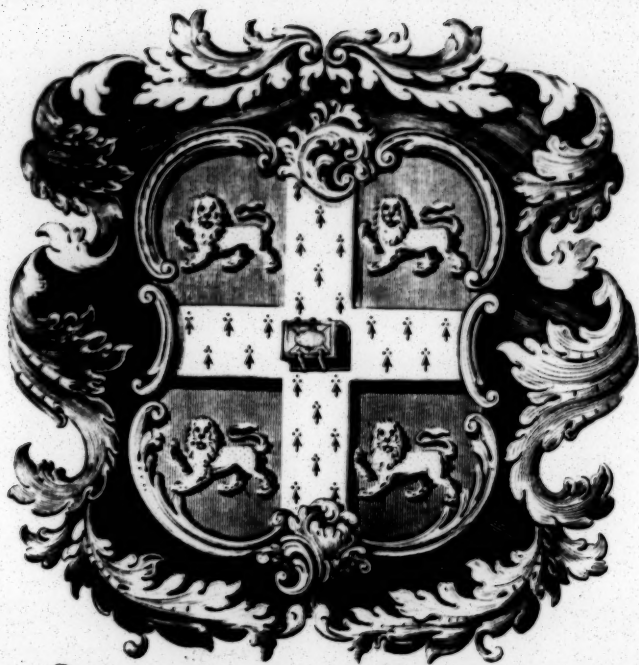
Rectifying ſeveral Opinions, &c. of the learned AUTHOR.

By a P H Y S I C I A N.

The S E C O N D E D I T I O N.

L O N D O N:

Printed for J. WILFORD, behind the *Chapter-house* in
St. Paul's Church-yard. M.DCC.XXXIV.



Academia Cantabrigiensis
Liber.

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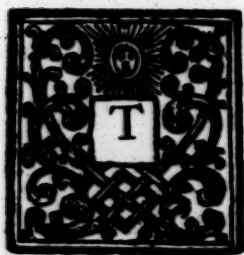
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P R E F A C E

T O T H E

R E A D E R S .



THE Original of these Sheets being very voluminous, and containing many superfluous Circumlocutions, contributes to raise the Price of the Books and deters the Purchasers from its perusal; but this Abridgment, I hope, has help'd those Inconveniencies, and yet, I can assure you, it contains the whole, except the Author's Dcdication, which only gives us to know how his Brother from studying Physick became a Divine, and

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how the Author from a Student of Divinity took to Physick.

The Author calls his first Volume The Theory of Chymistry, imitating Le Febvre ; but, except his long Detail on Menstrua, little of the whole retains to this Art, being a Piece of Physicks taken from Du Hamel, Le Clerc, and some others ; and it relates as much to Agriculture or any other Art, as to this. Lemery and Freind join'd do only contain the true Theory of Chymistry, the one accounting in a Physical, and the other in a Mathematical way, for all the phænomena produc'd by Chymistry: Let Physicians, who have enter'd the Lists without a liberal Education, decry this mix'd Reasoning in all the Branches of Physick, till they are adjudg'd Ignorant, and spurn'd for these their vain Attempts: Let this short Answer give them to understand their unpitied Mistake, namely, that wherever Quantity or Motion are to be accounted

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accounted for, *Mathematicks* take place; but where *Qualities* are the Theme, then *Experience* back'd by *Experiments* serve the turn; and as sometimes *All* come in play at once, then must our *Rationale* be mix'd: Now as all *Diseases* do depend on One or more of these, how lame do such *Physicians*, as are ignorant of either, appear in their *Writings*! and if they chance to be unskilful in either, as God knows too many really are, what crude and indigested *Works* do the *Shops* abound with! I have spoke enough to such as take me, and nothing would be enough for such as don't.

I wish this *Treatise* had aim'd more at the *Correlation* between *Animal* and *Chymical Actions*; this is not the only *Difference* between the *Author* and me; I have sufficient *Grounds* for varying from his *Opinions*, which I may some other time clear up; at present I shall only take notice, that this *Abridgment* took its rise from *Curiosity* and a strong desire

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desire of seeing how he would appear when stripp'd of his Harangues, which I did at hours free from Business ; the Remarks I have made are fewer than might be, but are too numerous for an Epitome.



T H E



T H E D E S I G N.



OUR desires are to learn, and mine to shew you, the advantages of chymistry.

Which I shall do by explaining to you all that is contain'd in authors, as well as all the processes.

Which is not very easy to be done, since we proceed upon things discover'd by chance, and not by rules; since a huddled collection of events, and not any general reasoning, gave birth to this art.

But I shall shew you the effects producible, and reason as well as I can, which however a *suite* of negligence in preceding artists, in forgetting many niceties, renders more difficult to me.

I shall divide these Institutions into three parts; in the first I shall shew you the origin, progress, and increase, recite the authors, shew where they agreed or disagreed, their sects, and give them their due encomiums.

In the second, I shall shew you the rules and all generals belonging to the art.

Nor do I own any other theory than what is built on observations, that are constant; nor shall I extend this further than to Particulars, which are often so confin'd, as not to be common to others.

I shall make use of the mechanicks in this theory, and of the properties common to all bodies; yet so as not to omit particular ones; as for example, *Galilæus* his laws of falling bodies are thwarted if a falling magnet happens within the sphere of another active loadstone; and *Archimedes*'s on æquiponderants in water, where Gold is suspended in Aqua regia, whilst it falls in any other liquid.

I shall therefore shew what is discover'd, and so promote the art.

In the last, I shall shew you the operations themselves, and all their varieties, where nothing shall be *repeated* unnecessarily, but the simplest shall precede, and the most compounded shall follow.

Thus the theorems in the first part will serve as a direction to understand the latter; and thus shall we arrive at perfection; since the processes of themselves wou'd be of little use.

T H E



THE
ELEMENTS
OF
CHYMISTRY.

PART I.
Of the CHYMICAL COURSE.

Concerning the HISTORY of the ART.

Of the Name.



T is written by the Greeks *χημία* or *χημία*, and is reputed an antidiluvian art.

So thinks *Zosimus Panopolita*, known to *Agricola*, and as *Scaliger* has it from thence, that the art deliver'd to the daughters of men by dæmons for their favours was call'd *χημία*, and in *Eusebius's* notes it is said that these dæmons deliver'd to them a book call'd *χημᾶ*, and the art it contain'd was call'd *χημία*. This fiction arises from mistaking

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the scriptural expression of the *sons of men* for devils; as *Sibylla*, from (a) $\Sigma\iota\beta\iota\lambda\alpha$, that is, $\Delta\iota\beta\iota\beta\iota\lambda\alpha$ in *Æolick*, for $\Delta\iota\beta\iota\beta\iota\lambda\alpha$ in reward of love, had got the art of prophesying. So far for fictions.

Egypt was formerly call'd $\chi\eta\mu\iota\alpha$ and $\text{Ἑρμειοχ\eta\mu\iota\alpha}$: but $\chi\eta\mu\iota\alpha$ in *Arabick* is *to hide*, according to *Bochart* (b).

Hence the name is antediluvian, and it signified the knowledge of the works of nature, the book of that knowledge, and *Hermes* mentions it.

If we write it $\chi\eta\mu\iota\alpha$. 'tis the hidden art; if $\chi\eta\mu\iota\alpha$, it signifies the black of the eye, that is the same as somewhat hidden (c).

Egypt the Land of *Cham* was call'd $\text{Ἀμ\epsilon\iota\iota\iota\iota\iota}$, which signifies *hidden* according to *Plutarch*.

At this time it is call'd *Chemi* by the *Cophthites*.

Hence this hidden art is call'd *Chemi*, *Chemia*, *Alchemia*, *Alkumia*, $\chi\eta\mu\iota\alpha$, $\chi\eta\mu\iota\alpha$, $\mu\iota\sigma\tau\eta\tau\iota\kappa\eta$: *Spagyria* and the *Hyssopick art* is an art to separate pure from impure.

At first it signified all natural science, and came afterwards to signify magick, and at last metallurgy.

(a) Our author mistakes the *Greek* dialects; for search and you will not find that Λ is chang'd into Σ , nor α into $\upsilon\lambda$, nor Θ into α . So that the whole fabulous derivation is a piece of sham-learning.

(b) If we must rely on the similitude of names, why may we not derive the word *chymistry* from the *Hebrew* חַמַּח *calefecit*, or from חַמ *calidus*, or חַמָּה *calor*, *sol*, all which signify *heat*, and as chymical preparations are mostly done by heat, it wou'd, if derivations are of any force at all, denote the art by the means thro' which we obtain our ends; but then we ought to call the art *Chamistry*: strange trifling! The *Hebrew* חָמַס is *recondere*, *to hide*; but חָמָה is *desiderare*, *to wish for*. We see what superficial knowledge is etymology!

(c) $\text{Χ\eta\mu\iota\omega\varsigma}$, and not $\chi\eta\mu\iota\alpha$, is the *Greek* word. חַמּוֹן is *multitudo*, as if it were *populous*; or *nutritius*, as if it were a plentiful place; but חָמַס is *to hide*: What a weak defence is this to prove chymistry very antient?

This

This metallurgy was first practis'd by *Tubal-Cain*, the poets *Vulcan*, *Gen. iv. 22.* for he made instruments of iron.

Brass, before it becomes malleable, requires twelve operations; and Iron requires a great deal of art to make it fit for tools.

Asia was the first place then that metallurgy was practis'd, for *Tubal-Cain* liv'd here, *Gen. iv. 22.* and compound the true and poetical history of *Tubal-Cain* and *Vulcan*, you will find, they meant one and the same person (d).

From hence it came to *Egypt*, and *Moses* knew how to mix Gold with water, (*Exod. xxxii. 20.*) an art not now known; and *Diodorus Siculus* says *Vulcan* reign'd first in *Egypt*, was esteem'd a god after his death, for having found out fire, or rather, tools of Iron.

Egypt is call'd *χημία* and *ἑρμωχίμη*, 'tis also call'd *Ἡραυσία*, or *Vulcania*; the art *χημία* by the *Egyptians* is call'd *μηθ*, and the *ποιητικὴ* is chymistry (e).

A temple was built at *Memphis* in honour of *Vulcan*, and his symbol was a vultur: *Ἡραυσ* comes from *ἄρω*, to burn. See *Horace, carm. 1, 4, 7.* and *Plaut. Amphitr. 101, 185.*

These authorities shew us that metallurgy first begun in *Egypt*; so that the art and name are ascertain'd.

Some time after, the word *chemia* begun to signify alchemy, or that art which chang'd any metals into Gold, which shews its original to be *Arabic* by the article *al*.

(d) Here the false is fuller than the true copy of our author, for he says *תובל קין* by throwing off *תו* 'tis *בלקין*, and *Bhalcan* being pronounc'd *Valcan*, hence *Vulcan* by corruption.

(e) *Conr. c. 3. Reinesf. Var. Lect. 1. 2. c. 5.* I should be glad to know one chymical remedy ever known till within these 200 and odd years.

Suidas, who liv'd in the tenth age, on the word *χημία*, writes that *Dioclesian*, who reigned the twenty last years of the third century, commanded all the books on this art to be burnt, because the *Egyptians* were inventing plots against the *Roman* empire.

And on the word *δερμα*, *corium*, he says, the *Argonauts* had a book written in leather that contain'd the art of making Gold by *χημία*: but as from *Pliny* to *Moses* nothing is said of this, we may believe it a fiction; for this would be bringing this art up to 13 centuries higher than our Saviour.

As to what *Pliny* (f) or *Dion Cassius* (g) write on *Tiberius* rejecting flexible Glass, or as to what *Pliny the younger* (h) says of *Caius* making Gold out of *Arsenick*, 'tis not to the purpose, since these shew us the art of making Glass and the domestic art.

I confess *Julius Maternus Firmicus*, in the beginning of the fourth century, 3. *Mathes.* 55. writes of alchimy as a known art, if the text of this author be genuine.

And *Aeneas Gazæus*, in the fifth century, talks of alchimy, or the changing of Silver and Tin into Gold, as an art well known (i).

Also *Clarius Anastasius*, in the fifth or seventh century, talks of *χημεία* and *χρυσοκολλητής* (k).

In the seventh century, *Georgius Syncellus* treats on alchimy expressly. After this many authors appear'd on this subject in *Greek MSS* (l).

On

(f) 35. 25.

(g) 57. p. 617.

(h) 33. 4.

(i) Bibliothec. Patr. V. 2. p. 373.

(k) Voss. l. 1. p. 25. Fabric. Bibl. Gr. v. p. 313.

(l) Synesius at Leyden in L. Democriti. Sossymus l. 24.

Olympiodorus Alexand. Joan. Archisacerdos; Stephanus Philos. Oros; Sophar; Hermes; Dioscoursus Sacerdos; Ostanes; Moses Propheta; Maria Hebræa; Pelagias Philos. Porphyrius; Epibychius;

On these Greek authors see *Libarius*, especially against *Guibertus*, *Conring. de Med. Herm.* p. 21. ad 31. *Borrich. Ort. Ch.* 97. and against *Conrig.* from p. 66. to 95. *Joann. Albert. Fabric. Bibliothec. gr.* and the catalogue of the library of *Leyden*.

George Agricola knew all these authors; *Erasmus* extols his works; he recites many authors that wrote on this subject in his preface.

All those authors do only speak of converting all metals into Gold, but say nothing of any panpharmacon (*m*).

The *Arabians* spoke in metaphors and in hieroglyphicks, their methods were call'd medicines, impure metals, sick men; Gold, a sound person; the dross of impure metals was call'd a leprosy; and the ignorant thought they spoke of diseases.

They call'd the instrument their philosophers stone, the gift of azoth, and those who had the secret, adepts; and they thought by it to transmute impure into pure metals or Gold.

And as chymistry by its remedies procur'd health, as *Rhazes* gave examples, and *Avicen* taught on the *Arabian* *Jalab* or distill'd *Rose-water*,

The 11th century *L. de Vir. Cord.* and *Mesue* confirm'd.

The chief was *Geber* call'd the *Arabian*, but was a *Grecian*, in the seventh century; he wrote of alchimy or chymistry; *Morienus*; *Albertus Magnus*; *Roger Bacon*, an *English* monk; *George*

ehius; *Comarius Phil.* *Cleopatra uxor Ptolomæi*; *Cosma*; *Agathodæmon*; *Pappus*; *Heraclius*; *Salmana*; *Christianus*; *Theophrastus*; *Aretulaus*; *Claudianus*; *Sergius*; *Anepigraphus*; *Michael*; *Isis*; *Blemmidus*; *Nicephorus*; *Democritus*; *Hicrothius*; *Isaacus Monachus*.

(*m*) *Conring. de Med. Herm.* 15. 16.

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Riply, an *English* canon of *Bridlington*; *Arnoldus de Villa Nova*; *Raymund Lully* of *Barcelona*; *Johannes de Rupe-Sciffa*, a *Franciscan*; *Isaac Hollandus* and *Johannes Isaac Hollandus* of *Stolk* in *Holland*; *Basil Valentine*, a monk of *Erfort*, a most expert alchemist, who aim'd at an universal medicine.

What increased the reputation of chymistry was the curing the venereal disease with Mercury by *Carpus*, when the schools abounded with words without meaning, given from *Galen* and the *Arabians*.

The old physicians grew out of date, when all their elaborate works on causes, signs, diet, and remedies were baffled, and diseases cur'd with one remedy.

However, if fashion prevail'd for a while, their vanity appear'd at length, as may appear by *Paracelsus* and *Helmont's* boasts.

Paracelsus was the son of *William Hobenheim*, a trifling licentiate of physick, and bastard son of the master of the *Teutonic* order, who had a rich library, born at *Einsidlen* (which signifies a desert) in *Switzerland*; he was call'd from his town, an *Eremit*e, by *Erasmus*; he was said to have been an eunuch; he was taught by his father, *Trithemius*, and *Sigismund Fugger*, where he owns he learn'd his chymistry; he studied the adept philosophy under the best masters, who conceal'd nothing from him; then he travell'd thro' *Germany*, *Italy*, *France*, *Spain*, *Portugal*, *Poland*, &c. and learn'd every where *arcana*; he learnt from *Basil Valentine*, tho' he conceal'd his name, the three principles of Salt, Sulphur, and Mercury; he travell'd into *Russia*, was taken by the *Cham* of *Tartary*, sent to *Constantinople*, and was said at his 28th year to have the philosophers stone; he

he serv'd as surgeon and physician at sieges and battels; he admir'd *Hippocrates*, hated the school jargon and the *Arabians*; he admir'd Opium and Mercury, and cur'd great distempers, which others could not: he became famous and bold; he cur'd *Frobenius* at *Basil*, was invited thither, and taught philosophical (n) physick in *Latin* and *German*: he was known to *Erasmus*; he expounded his own books on Compositions, Degrees, and Tartar, where he talks much, according to *Helmont*, to little purpose; burnt *Galen* and *Avicen*, and said, if God pleas'd, he would consult the devil; he had many scholars, some of whom he maintain'd, who us'd him ill; he commends six of them; he cur'd the canon *Liechtenfests*, who instead of rewarding him, as he promis'd, jeer'd him, and said he had given him only three mouse-turds (*Laudanum*); he sued, and the judges allotted him so little, that he call'd them unjust blockheads, for which he was forc'd to leave the town; he left *Oporinus* his laboratory; he went into *Alsace* with *Oporinus*, and was as happy in curing as he was dissolute, as *Borrichius* tell us; he allured the learned *Oporinus* along with him, in hopes of diving into his secrets, but in vain, for he return'd to his family in *Basil*: the cause of *Oporinus's* leaving him was this, he was call'd to a countryman, but wou'd not leave his liquor till morning, he then went and ask'd if the fellow had taken any thing, they said, only the sacrament; Then, said he, if he has apply'd to another physician, he wants not my help: he had forgot his *Latin*, wander'd about, drank unmercifully, grew dirty, and dy'd at *Salisburg*, in an inn, the 24th of *Sept.* 1541, aged 47, altho' he promis'd

(n) Anno 1527.

himself long life by his elixir: he wrote some works (o).

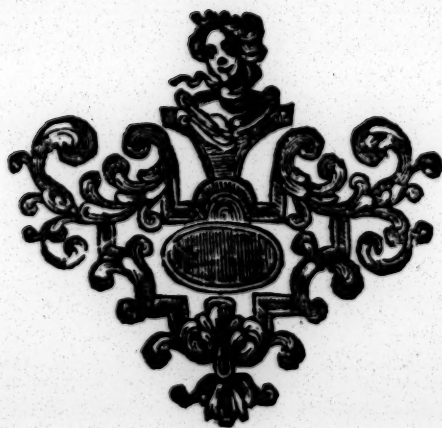
Helmont of *Brussels*, of noble parentage, born 1577, studied physick, ended his philosophy 1594, lov'd the antients, read chirurgical lectures at *Lovain*; was made doctor 1599, cur'd himself of the itch with sulphur, left his country, learnt chymistry, sold his all, and gave it amongst his relations; he married a rich wife, and liv'd at *Vilvoord*; he run the risque of his life by his experiments; he practis'd without fees; and says he cur'd thousands yearly; he spent fifty years thus, was invited by the emperor *Rudolph*, but refus'd it; he could not cure his sons of the plague, nor his eldest daughter of a leprosy, nor his wife nor maid, nor himself of poison: his son publish'd a large volume in *quarto*: he dy'd of a fever Dec. 30. 1644.

I conclude that neither this author nor *Paracelsus* had any universal medicine; nor did they live to an old age, as they hop'd.

Next came *Sylvius*, *Otto Tachenius*, and others, who introduc'd chymistry into the practice of physick; a catalogue of whom I here give you; to wit, *Crollius's Basilica Chymica*, *Beguini Tyrocinium Chemicum*, *J. Hartmanni Opera Medico Chymica*, *Glafer Traité de la Chymie*, *La Febure Traité de la Chymie*, *Lemery Cours de Chymie*, *Le Mort Chymia Medico-physica*, *Barchuysen Pyroso-phia*, *Geber reprinted*, *Georg. Agricola de Re Metallica*, *Lazar. Erkern Aula Subterranea*, *J. R. Glauberus*, *Joach. Beecher Metallurgia*, *J. Kunkel*

(o) Of Surgery; of Apostemes; of Tartar, &c. de Archidoxis; of Cures; of Health, and Elements of the Generation of natural Things; of Suppuration; of Signs, Characters, Adepts, Bleeding, the Origin of new Diseases, and Magick.

*Philosophia Chymica, Ol. Borrichii Docimastica
Metallica, Morienus, R. Bacon, G. Ripley, Raim.
Lully, Bernardus, J. Is. Hollandus, Is. Hollandus,
Basil Valentin, Artephius, Theatrum Chymicum,
Turba Philosophorum, Paracelsus, Iren. Phialetha,
Michael Sendivogius, Helmont, Boyle, J. Bobnius,
Cox and Slare, Homberg, Geoffrey, G. Ern. Stahl
Fundamenta Chymicæ, and Hoffman's Observationes
Physico-chymicæ.*





P A R T II.

On the THEORY of the Art.

CHYMISTRY is an art shewing how to change bodies by proper instruments, that their effects, and the causes from these effects, may be known.

'Tis an art, because it gives rules how to act, and requires a knowledge and acts of the understanding.

Its objects are all bodies that are or are made sensible. We divide them into three classes; *first*, Fossils or Minerals found in the Earth.

On M E T A L S.

These are the heaviest Fossils, they flow, cool, and are malleable. There are six, Gold, Silver, Copper, Tin, Iron, and Lead: To these the ancients added Quicksilver, tho' it be not ductile nor fix'd.

The *Persians* gave the same characters to the Metals as to the Planets; ☉, ♄, ♀, ♃, ♂, ♁, ♄.

The marks are hieroglyphicks, for + shews sharpness; ☉ perfection, no sharpness; ♄ half Gold; ♃ half perfection, no sharpness; ♁ the middle part Gold, the upper Silver, the lower sharpness, as if it were partly Gold, partly Silver, partly sharp

sharp and corroding; ♀ Gold and sharpness; ♂ Gold and half sharp; ♀ half Silver and half sharp; h partly sharp, partly Silver; ♂ Gold and sharpness.

The surest mark of Metals is their specifick gravity; and it stands thus with respect to Water; Water 1 ☉ 19 +; ♀ 14 +; h 11 +; ☾ 10 + or 11 +; ♀ 8 + 9; ♂ 7 + or 8; ♀ 7 +; Granat 3 or 4; Glafs 2 or 3: hence if Bodies weigh heavy, they are metallick; hence we see the difficulty of transmutation, and which, if any, is the most likely to resemble Gold.

☉ is the heaviest Metal, purest, most fix'd, and incorruptible, losing not a grain in an ounce in two months on the fire; it alone resists ♂ and h; 'tis so ductile that gr. i. gilds 36 inches square, and 24 square lines. 48 ♂. of Silver are gilded with 3i. of Gold; and one grain will make 500 feet in length; 'tis soft, not very elastick, nor sonorous; 'tis red, when melted, and *Madagascar* Gold melts like Lead; preparations of Salt dissolve it, it joins in with Quicksilver, if dissolved in Aqua Regia, and precipitated with Salt of Tartar, it fulminates; it neither rusts nor exhales; sometimes 'tis found pure, at other times mix'd with a white glebe, speckled with black spots, and Vitriols are found join'd to it.

It is separated from the Glebe by a reverberatory heat, by boiling in Water, by Quicksilver mix'd, by rubbing it with Quicksilver and Calx of Vitriol, and then by boiling in Water, by Aqua Regia, by Salts, or by washing in Water.

Quicksilver is next to Gold in gravity, unmix'd, volatile, divisible into small spheres, but not malleable, unites with Gold, Lead, Silver, but hardly with Copper or Iron, dissolv'd by Aqua Regia or Fortis.

Altho' it approaches nearest in weight to Gold, yet unless we can fix it, it is difficult to make it resemble Gold.

It is found chiefly in *Friuli* in a liver-colour'd stone, or in earth, or in round stones, or in Cinnabar.

It is separated from its glebe by sublimation, sifting and washing in Water; if it is found pure, it is call'd Virgin Quicksilver.

Lead is next in weight to Quicksilver, 'tis unmix'd, it fumes on the fire, and pierces thro' the vessels, and is not fix'd; 'tis the softest of all Metals, the least elastick, not sonorous, and very ductile; flows with a gentle fire, vitrifies soon, throws up light dross, soon congeals again, consumes all Metals save Gold and Silver; it dissolves in (a) Aqua Fortis, not Aqua Regia; it affords a sweet Salt; it is found in many places in *Europe*; its ore is ponderous, and is half Lead, it contains Silver.

Silver in weight is next to Lead, 'tis unmix'd, is fix'd, and wastes not in the fire, 'tis ductile, smelts, is dissolv'd in Aqua Fortis; it is depurated with Lead and flies not off, but with Antimony not so: it generally has a mixture of Gold in the ore; an antimonial Sulphur consumes it, Quicksilver tames it, which neither Salts nor Lead does, it unites with Quicksilver, and by sublimation you regain the Mercury.

Copper is next to Silver in weight, 'tis not so unmix'd as the preceding Metals, for 'tis somewhat volatile, but tolerably fix'd; 'tis ductile, elastick and sonorous, it grows red hot, then it melts, and if a drop of Water falls among it, it flies and endangers the workmens lives (b); any

(a) The weaker acids dissolve it soonest; moreover, it is known to contain Silver in it for the most part.

(b) And I'm told the same happens to all Metals.

acids dissolve it, and it gives green Cryftals, with Antimony and Lead it turns into Scorix or Glafs, and flies off in fmoak ; it is found in many places, in a ftone : it paffes 14 furnaces ere it becomes pure ; it often contains Silver, and Vitriols of all colours.

Iron is next to Copper in weight, 'tis lefs fimple or unmix'd than the other Metals, for it affords Sulphur and flames ; 'tis fix'd, but lofes weight in the fire ; 'tis ductile, and fonorous ; it grows red-hot ere it melts ; 'tis diffolv'd by any Salt, and grows rusty ; with Antimony and Lead it flies all off ; 'tis drawn by a Loadstone ; 'tis good in medicine ; it grows every where, in marle, in ftone, 'tis burnt ere 'tis got ; 'tis often found in green Calcanthum.

Tin is the lightest of all Metals, mix'd with Sulphur, lofes in the fire, ductile, not much elastic nor fonorous, flows easily, and hardens as soon, is diffolv'd with any acid after calcination, but in the ore only by Aqua Regia ; it mixes with Antimony and Lead, and is hardly feparable but by Copper ; it approaches near to Silver ; 'tis found plentifully in *England*, in a ftone or yellowish glebe ; 'tis got by burning, bruifing, washing and fmelting (c).

The history of Metals fhews us, 1. That Metals are different from all other bodies, being the higheft is doubly heavier than any other : 2. Hence it were foolifh to pretend to transmute any body not metallick into Metal : 3. The weight fhews the affinity of Metals to each other : 4. Nothing then refembles Gold nearer than Quickfilver : 5. The other properties, to wit, colour, malleablenefs, fixity, &c. may be the more readily

(c) *Britain* is from *Barat anac*, which in *Syriac* is the *Field of Tin* : Why not from *ברה* *ager*, and *אני* *navis*.

transmuted: 6. Gold then may be made of Quick-silver and some other simple principle: 7. Other Metals may be made of these: 8. And may be resolv'd into them: 9. That may be done by Quick-silver, some Salt or Fire: 10. Mercury then only by destroying its adjuncts may be transmuted into Gold: 11. Nor can any other Metals than the six named be made: 12. The weight then prevents cheats and spurious Metals: 13. All Metals when melted resemble Quicksilver in colour, solidity, attraction, mobility, and flexibility; Mercury is fusible with a small heat, Tin with a greater, Lead with a greater than Tin, Gold and Silver with yet a greater, Copper with a greater, and Iron with the greatest of all.

Of *S A L T S*.

Next to Metals we shall treat of Salts, call'd concreted Juices; all Fossiles that flow on the fire or melt in water are call'd Salts; so (c) simple that each particle is alike in taste.

The natural Salts are Sea Salt, Sal Gem, or Salt of Fountains, Salt-petre, Borax, natural Sal Armoniac, Alum, and the Acid of the Mines.

Sal Gem is taken out of the earth; the *Salt of Fountains* is got from water; *Sea Salt* is Salt crystallis'd from Sea water: These three are of one and the same nature, for they all dissolve in $3 \frac{1}{4}$ of water, run in the air, give like crystals, *sc.* cubical, parallelopipedal or pyramidal, being put to Aqua Fortis dissolve Gold, give out an acid spirit, leave at bottom an austere fattish liquor, crackle and flow in the fire, are not chang'd in it, give no alcali, nor do they putrefy, &c.

(d) Uncompounded similar.

Salt-

Salt-petre is of a prismatical figure, dug from the earth, melts on the fire, 'tis fixt, affords little water; with any sulphurous matter it deflagrates; it proceeds from animals putrified that use no Sea-salt; hence from dungs, &c. 'Tis dissolved in $6\frac{1}{3}$ of water.

Borax; its figure is various, dissolves in 20 parts of warm water, runs on the fire into scum, is bitterish, gives out water, promotes smelting, and foders.

Sal-armoniack, got in *Libya*, near *Ammon's* temple, and Mount *Vesuvius*; the factitious is from Soot, Bittern, &c.

Acid Salt is every where in the bowels of the earth, uniting with metals into Vitriols, with oils in Sulphurs; 'tis this Salt that in burning Sulphur choaks the by-standers.

(e) *Alum* is got from a Stone that contains a Bitumen, expos'd to the air, that runs into powder, is burnt, dissolv'd in water, and precipitated with an alkaline Salt; so 'tis a new Salt from air, alcali and a fossile Salt: The matter that is precipitated is separated, boil'd in water, thicken'd in a leaden vessel, put into a hoghead in a cool place to crystallize into octohedral crystals that are acerb: Its acid Spirit resembles spirit of Sulphur, its *terra damnata* resembles Bole, which calcin'd with three parts of any combustible matter, gives a phosphorus (f). Hence spirits of Salt, of Nitre and Sulphur are all the acids extant.

(e) Spirit of Sulphur and Chalk make an Alum by crystallization.

(f) A Mistake; for Spirit of Vitriol is different from all, as experiments convince us.

Of S U L P H U R S.

Brimstone is hard, melts, flies off by fire, burns blue, and its steams choak. *Live Brimstone* is yellow as Amber, red or ash-coloured; *common Brimstone* is got out of the Pyrites with fire, *per descensum*; it is composed of Oils of Calcanthum, Alum and Sulphur *per Campanam*, and some oily matter combin'd; 'tis called Refin; it is sold in rolls, which are made by often melting it, and scumming and pouring it into wooden models.

Orpiment. The Orpiment of the ancients, called now Realgar, Sandarack, and Red Arsenick, differs from our modern Arsenicks; the first is not so hurtful as is said, but the latter is poisonous; for the white Arsenick is the flowers of Cobalt calcin'd with fix'd Salt and Flints; the yellow is the flowers of Cobalt calcin'd with that of common Brimstone, and the red is the flowers of the same Cobalt calcin'd with $\frac{1}{2}$ of Brimstone; the latter then is poisonous, nor was it known to the ancients, its preparation being not discovered above 200 years.

Petroleum is a stinking oil from the rocks and waters, suppos'd to be a Bitumen, melted by subterraneous fire.

Naphtha; it is a thinner Petroleum called the flower of Bitumen.

Asphaltum is thicker than the two preceding, swims on waters, and burns furiously.

Jewish Pitch, *Bitumen Judaicum*, being melted, becomes as hard as Pitch; 'tis heavy, fusible, mixes with any oil, and is inflammable.

Pissasphaltum is betwixt Pitch and Asphaltum; 'tis black, smells strong, and differs from the others in degree.

Jet

Jet, Gagates is black Canal Coal found in *Lancashire*.

Lithanthrax, is a mixture of Coal and Stone; it is our Sea-coal, and needs no description.

Amber, Succinum, Electrum, is a Bitumen made of Salt and Oil; it is yellow, white, black and red.

Oil of the Earth, Oleum Terræ; it is kept by the kings of *Asia*, and seldom brought hither; that which we have, is made of Oil of *Cocoanuts* express'd, and some earth mix'd; so may our *Barbadoes Tar*.

Of S T O N E S.

They are a hard friable Fossile, that neither fuse in the fire, nor melt in water. They are divided into *pellucid*, such are Gems that are like Glass, are hard, simple, hot, easily fus'd, and seem to consist of fire, earth and salt; *Cryстал* resembles fine Glass, 'tis hard to melt; *Diamonds* are not to be melted, are the hardest Gem, and the most resplendent. *False Diamonds* are less solid and shining. *White Sapphire* resembles a Diamond, so does a white *Indian Amethyst*, as *Topazes* and *Chrysolites* being deprived of all their colour do; the *Astroites* is referr'd to pellucid Gems; coloured Gems have somewhat metallick in them, as fictitious ones have. The *Amethyst*, *Beril*, *Carbuncle*, *Chrysolite*, *Granate*, *Hyacinth*, *Opal*, *Ruby*, *Sapphire*, *Emerald*, *Topaz*, and coloured *Cryсталs* are referred hither. What gives a value to all Gems, is their hardness and glistening. *Semiopac* are the *Achates*, *Sand*, *Astroites*, *Armenian Toadstone*, *Carneol*, *Chalcedonian*, *True Jasper*, *Lapis Lazuli*, *Nephiticus*, *Cat's-Eye*, *Malachites*, *Onyx*, *Sardian*, *Sardonyx*, *Selenitis*, *Turkey-stone*; and the value of these is enhanced

by their solidity and colour. The *Opac* are Eagle-stone, Alabaster, Amianthus, Belemnites, Limestone, Blood-stone, Jasper, Lapis Judaicus, Touchstone, Load-stone, Marble of all sorts; Ophitis, Osteocolla, Pumice, Whet-stone, Mill-stone, Flint, Specular-stone, Emery, Talc, Tripoline-stone. Some of these are convertible into Glass, others not.

Earths that are made into paste with water, are Boles, Marle, Fat of the Earth, Fullers, white Bole-armoniac, of Chio, Lemnia, yellow Meletana and Radele, Samian, Selinusan, Scald and Tocay; some less fat, are Chalk, Ochre, and fat Clay.

Of S E M I - M E T A L S.

They are Vitriols, or Metal and Salt joined together; such are Copperas, Colcothar and all Vitriols. The most common are of Iron or Brass; tho' the air makes Tin and Lead into Ceruss's; but Copperas and Verdigrease are the commonest.

The same acid dissolves either Iron or Brass; Vitriol and Sulphur are found together, and therefore the acid Spirit does frame the Vitriol.

There are five sorts of Vitriol; the *green* from Iron; the *blue* from Copper, the *white* is Iron higher digested; *Colcothar* is Iron; *Hungarian* or *Cyprian* is blue, and is Copper; all made with an acid: From Sory we get a Vitriol by water. Melanteria is a black caustick Vitriol.

Some Acid in water in the Bowels of the Earth eroding the Metal, gives all these Vitriols.

Some Semi-Metals are from Metal and Sulphur;
 1. *Native Cinnabar* is a Coalition of Sulphur and Quick-silver, as *Analysis* shews. 2. Antimony is Sulphur and a metallick Earth of a peculiar kind, which is brittle, volatile and of a golden colour;
 and

and it is *arsenical*. 3. *Bismuth*, its Metal resembles Silver, but it is brittle ; Zinc resembles Bismuth.

To Semi-Metals may be referred *Armenian Stone*, *Cyaneus*, *Lazuli*, because they have metallick Veins in them ; as also the *Hæmatitis*, for it abounds with Iron and sublimes ; so the *Loadstone* has Iron in it : *Ochre* is Iron and fat earth.

We see then what are the principles of Fossiles, to wit, Metals, Sulphur, Salts, Earth, &c.

Of VEGETABLES or PLANTS,
or HYGRAULICK BODIES.

They suck their nourishment thro' pipes, and differ plainly from Fossiles ; and their receiving their nourishment from the root, distinguishes them from Animals ; their solid parts are Earth glued together. All their parts differ in virtue ; the *Root* is design'd for fixing the Plant to the ground, and receiving nourishment ; for that end it is porous, and resembles the *Lacteals* in Animals ; the juice is only earth and water, crude but heterogeneous, not resembling the proper nature of the plant ; these juices ascend into the plant, as is seen by piercing *Birch* in *March*, and then they are changed into the proper nature of it ; the *Leaves* are the lungs, they are full of vessels, and are thin and exposed to the air ; the juice they sweat out at night is a viscous juice, such as honey, wax, &c. The *Flowers* afford a juice fit for nourishing the Seed, as also honey and wax, ; its juice is grateful to the Seed. The Seed is the embryo of the Plant, it has a *Placenta* and a *Cotyledone* or more, which is the *Funiculus* ; this *Cotyledone* contains a *Balsam* which is partly viscous and partly spirituous, the first hinders the nutriment flying off, the other serves to fecundate

it ; the viscous part never enters the Seed, but the spirit is a quintessence for its refreshment. The *Trunk* requires an oil to keep it supple ; the *Bark* contains a fat and thicker oil, which affords an Acid ; this defends the tree from injuries of air and water ; it thickens into Balsams, Gums and Resins. The Cinnamon, the Barks of *Peru*, of Capers, Tamarisc and others, make this plain. Each Plant has its *peculiar Juice*, in which its specific virtue resides : If the greater Celandine be prick'd, you get a golden juice in which its virtue resides ; if you prick the Poppy, a milky juice issues, which is Opiate. In like manner, in the Aloes ; nay each part of the plant has its *peculiar Juice*, which should be known to those who practise. In general, Plants afford a spirituous or soapy Oil, an Acid, and Alcaline fix'd and volatile, and a neutral Salt as well as Earth.

Of ANIMALS.

The third species of bodies that are the subject of Chymistry, is Animals, where I only understand the corporeal parts ; they are hydraulick bodies also ; in them the Lacteals are as roots, the Food is as earth, the Mouth is the pores of the root ; so that we resemble, as do all Animals, a Plant in this affair : The eggs of Birds have their Placenta to suck in nourishment ; so far Plants and Animals agree : We see Plants grow in waters, on earth, and on both ; we also see aquatick, terrestrial and amphibious Animals ; their matter is alike, for their nourishment is ; as in the Chyle, so in the Juices of Plants there is a native crudity, that can't be called an animal or vegetable juice, but which the more it circulates, the more it is chang'd : In Animals there is a Spirit residing in the subtil Oil, that distinguishes one individual

dividual from another, as may be seen in dogs smelling out their masters in the greatest crowds: Animals do also abound with water; Salts also are found, none fix'd nor volatile but by fire, nor are acid Salts ever found. No Alcalick has been found, altho' the water from five days suppression was tried (g). *Putrefaction* makes all alcalick, the natural resembles Salt-Armoniack, tho' somewhat different: Having essayed the Salt of Animals, I find it a saponaceous, volatile, fix'd and oily, and apt to putrify: and the Urine affords a fix'd Salt, by burning, which is from the (h) Sea-Salt in it: And if some have tortured the Blood, and found an Acid in it, this is from the Sea-Salt in it. Animals that use no Sea-Salt have no Acid in their Blood nor fix'd Salt.

Chymistry finds Animal Oils very various, some are very subtile, miscible with water, and easily made volatile; others are fatty and smooth, and fit for lubricating, void of Salts; others again saponaceous; another is mixt with earth, is hard to be distilled, and is tenacious and unites the parts, another is fiery, called *phosphorus*, and flames and leaves an Acid behind (i).

They contain also earthy parts, which give solidity to bodies: The earth of Vegetables and Animals don't differ, for Cupels are made equally of both.

These are all that are found in Animals; yet confound them together, and you can't produce

(g) I have found Serum turn Syrup of Violets green, and sublimate water white; therefore it contain'd a volatile Salt.

The fix'd and acid Salt are united together into an armoniacal or saline Salt; for fix'd Alcalines attract Acids stronger than Volatiles; therefore no fix'd Salt, nor any Acid are found separate, but may be separated chymically.

(h) He forgets this in the sequel, and denies that Sea Salt has any fix'd Salt in it.

(i) All Oil is the same, but only varies by mixtures with other Bodies.

a liquor like what you draw them from ; Bile, Semen, Spirits, Milk, Fat, Lymph, Spittle, Urine, and all others differ from each other, and all are separated from the Blood. There is no difference between the Elements of Plants and Animals, their structures only differ. So far of the objects of Chymistry.

Chymistry handles all Bodies of the three Kingdoms ; it acts by motion, and either unites or separates Bodies by Commistion or Fire. *Motion* produces strange varieties ; we may wonder how from so few principles such varieties happen, but consider Combinations, consider the Magnet and its Phænomena ; consider Menstrua, and you will be convinc'd.

Consider how the figure of Iron being chang'd, produces Keys, Knives, &c. and how many effects are produced by this one change, the matter being unchang'd.

The simplicity of the chymical operations, which are calcining, fixing, vitrifying, subliming, fermenting, putrifying, digesting, depurating, uniting, and the like, does not hinder, that a vast variety of effects may be produced from thence.

Parts were not not such in Bodies as they appear when separated ; their effects are not the same as those of the compounds ; we can't reason from the one to the other (*k*).

When we have divided Bodies into their Atoms, or initial Corpuscles; Art goes no further, unless we compound them again.

We never get the Elements pure, Chymistry yet never perform'd this feat.

(*k*) Why so ? Compounded Bodies indeed can't act like simple ones, but whenever they are made use of, they act in a compound *ratio* of their various Components.

Fire may perhaps be the purest, but Water, Air and Earth are compounded ; you can divide the simplest Bodies, as Water, Spirits, Salts and Alcohol of Wine into different matters ; nor can we reproduce the same substances, as blood, &c. from whence they were drawn.

Let us not extol Chymistry beyond truth : Its operations are limited and determined ; Bodies were not the same in the Bodies as we see them produced ; there's no Spirit of Wine, for example, to be had without fermentation, which changes Bodies.

There is a *Spiritus Rector* in all Bodies, which gives the individual smell or taste ; 'tis so fine as not to be caught, but flies off into the clouds, and returns and impregnates other Bodies again ; this Spirit resides in the subtile Oil of Bodies, which flies off at death ; 'tis not above 8200 parts of this Oil ; 'tis so active that 'tis called Son of the Sun, Vital Spark, &c. But I will produce an example of this affair ; Distil Cinnamon-water, leave it open it loses its fragrancy, but no weight ; expose the Oil, it loses its fine odour, but loses little or no weight, what flies off is the *Spiritus Rector*. Some (1) pretend this Spirit is in Metals also.

The products of Chymistry are reduced to four classes, to wit, *Extracts* (as of Wormwood of Steel, distilled Waters, Decoctions, Inspissations and Tinctures) *Clyssi*, (Soaps, &c.) *Magisteries* and *Elixirs*. The explication of these may be seen any where.

(1) This *Spiritus Rector* is a sort of an Ubiquitarian by our author's account : however it is what others call the most volatile and ethereal Oil.

Of the Use of C H Y M I S T R Y in NATURAL PHILOSOPHY.

By help of the fire we discover what Bodies are compounded of ; Chymistry helps us to discover the properties of Bodies, by knowing their Elements ; mechanical Philosophers indeed have discovered to us the common properties already ; as of the Magnet, &c. but Chymists alone must detect, by their experiments, peculiar appearances, such as Ignitions, Explosions, Effervescences of Gunpowder, Phosphorus, Vitrification, Fermentation, and the like ; they spurn at substantial Forms, and search after the *Phænomena* peculiar to each Body, they laugh at all occult Qualities, they shew their appearances to the eye ; indeed they don't pretend to explain a *plastick Power*, but that once granted, they proceed on experiments which they owe to a *Verulam* and a *Boyle*.

Of the Use of C H Y M I S T R Y in PHYSICK.

It shews us that the Solids are Earth and a glutinous Oil, to which a little water is applied, deriv'd from our nourishment : It shews us the nature of our Fluids, and the Thermometer shews us the degree of Heat in us.

And as the Hydraulicks shew us, and discover daily more *Phænomena* on the Motion of the Fluids within our Vessels, so does Chymistry daily discover new properties in Bodies, both which advance the Physiology very much : I speak of true Chymistry. Anatomy belongs to Mechanicks, the Motion of the Fluids to Hydraulicks, Chymistry shews the peculiar attractions and other properties of Bodies.

It

It conduces towards *Pathology*, because our Juices grow thick, move slower or faster by mixtures, grow acrid many ways, are dissolved, do putrify, and such like, and we can't explain these without Chymistry.

It helps the *Prognosticks*; for how can we explain the greater frequency of the Pulse, the Colour, Taste, Contents, &c. of the Urine, the nature of the Sweats, Spittle, Pus, Fæces, &c. without its assistance? When the Pulse augments the Heat by its frequency, the thinnest parts fly off, the rest thicken, the Oils are dissolved, are made acrid, volatile and putrid; the Salts are also render'd volatile, and from gentle and saponaceous, become caustick.

It guides us in the *Dietetick Part*; for without its knowledge we can't guess how persons that exercise too much have a putrid Blood; how Acids and neutral Salts profit such; how the sedentary want exercise and things of easy digestion; all which, and many more, Chymistry accounts for.

As to the *Curative Part*, it conduces mainly; for we can't give victuals without knowing their principles, which ought to be contrary to any reigning preternatural state; Remedies are prepared by it that correct and expel, lenify and restore. I desire you to read my *Methodus Medendi*, *Verulam*, *Boyle*, *English* and *French Transactions*, the *German Ephemerides*, *Bohnius* and *Hoffman*; I omit *Sylvius* and *Tachenius*, because they stretch'd its use too far; and read my *Aphorisms*.

Of the Use of CHYMISTRY in MECHANICAL ARTS.

By Mechanical Arts I do not understand Geometry, but such Arts as require the dexterity of
the

the hand : As to Painting, the delight of Princes, Chymistry helps it very much. Thus Ultramarine, the most beautiful blue, is made out of Lapis Lazuli, so is Smalt, another blue ; as also the beautiful green, and another blue dearer than Gold ; all which are immutable by the Air ; so are Lacquers, and other black colours made use of by Painters, all made by the Art of Chymistry ; likewise Enamelling, which cruffs over Gold like unto Glass, made of a metallick Matter and fix'd Salts. Painting likewise in Glass, which formerly was used for Church Windows, as we see in *Tergow*, and which now is lost, if ever, must be restored by Chymistry.

Dying also is performed by this Art, which requires three things, to wit, washing with Lies, digesting and beating ; the Lies are made of Urine, fix'd Salts, Soaps or Gall, which take off the oily parts. *2dly*, The grinding of the Colours, so that they may penetrate well ; *Cornelius Drebell* found out a particular art of dying the *couleur de Feu* or Scarlets, by mixing Cochineal and Spirit of Nitre, and boiling them in a Tin Vessel along with Water ; without the latter circumstance, the Spirit of Nitre would have eroded the Stuffs. *3dly*, The colours must be beautiful which this art teaches to make : I remember some time ago to have shew'd to Masters of this art, colours produced from Copper so lively, that they wished they could dye their cloaths of so beautiful a colour, and there is no doubt but this may be improv'd.

Glass-making, which is most useful to Mankind ; by Glasses old eyes and short sights are assisted ; by this we are able to see all things plain, being at the same time defended from Heats and Colds ; by this we keep things for ever, nothing corrodes them, even the Alkahest does not touch them ;

it was improved in *Agypt*; in *Tiberius's* time it was made malleable, and at *Venice* and in *England*, it is made very fine, of Sand, Flints and other Stones, along with fix'd Salts or Ashes of Plants, which if too many, make the Glas finer, but it's apt to crack, and makes Bodies put into them to corrupt; whereas in Glas that is green, green Tea, *v. g.* will remain uncorrupted for ever; hence for keeping things chuse green Glas. Read *Neri*, *Agricola*, *Merret*, and *Kunckel*.

As to making artificial Gems, Chymistry has invented how to strike Glas with all colours, and if we could make them one and a half heavier, they would equal true Gems, but Lead makes them softer; whereas if to this weight we could find how to make them harder, and strike a fine colour, they would be valuable; but all this must be found out by Chymistry; for this end Crystals may be made use of; and some have endeavoured by heating them, and plunging them into metallick Tinctures to strike their colour, but thus made they are apt to crack; others have cemented Crystals with Metals, and others again have made metallick Pigments, crufted Crystals with them, and melted those in the fire.

Chymistry shews how to make Metals fit for the various uses of mankind; I speak not of Transmutation; if Gold be too pale, the Regulus of Antimony gives it a fine colour; if it be too flexible, it is made harder by Copper, as is Silver; Brass is made by Copper and Lapis Calaminaris; Princes-Metal is made of Brass and Zinc, which being gilded, looks like Gold; and how to gild or silver baser Metals; antimonial or medicinal Cups are made by Chymistry. I wish *Helmont* had told his secret to us of metallick Rings that cured hemorrhoidal pains and convulsions! It also shews us how to turn Ores into Metal. It has taught us
how

how to make Gold and Silver volatile, and how to fix them, as is now practised in *Peru*, with the Silver which they mix with Quicksilver, and then call it off, by which artifice they lose nothing. Take Butter of Antimony, put it into water, then smelt it, and it becomes a Mass like Silver. Try Metals thus. Sulphur is deprived of its virtue of snatching up Metals, by adding Iron to it whilst it is calcining; and fix'd Salts do also prevent Sulphurs from making Metals volatile. Thus much for Metals.

In the *Art of War* what improvements has not Chymistry made! view Gunpowder invented by *Bacon*, improv'd by *Schwartz*, and communicated to the *Venetians*, further advanced by *Coeborn*, with Nitre, Sulphur, and the Lees of Wine calcin'd. See chymical Oils mixt with double Spirit of Nitre, and Balsam of Sulphur in a Glass on the fire, and then wonder.

In *Natural Magick* Chymistry has a large share, Magick was not always taken in an ill sense, for the *Magi* were reputed *wise men*: So *Zoroastes*, the *Persian Kings*, and the *Magi* of the scripture were esteemed; as to the *Magi*, whether they could do such strange feats as are said, I don't enquire, but that nature can effect wonderful Phenomena is certain; what would people have thought of a man that wou'd have told them 1000 years ago, he could blow up a tower at a distance? And yet we now know this to be done by art. What if at that time they should have foretold an earthquake at a certain hour? Yet now 'tis done by fresh filings of Iron and Sulphur in equal parts moistened with a little water, buried under ground; how was a young rake recalled by Phosphorus, his name being written with it at his bed's-foot, and called on by his chamber-fellow to see the wonder? See its effects in authors. How
do

do two cold liquors fall into a flame in an instant with a trifling quantity of them ; what might not be done with a greater ? And how much more do they flame in the exhausted receiver ? See *Hoffman* l. 3. *Obs.* 15. how Spirit of Wine with a lighted brimstone match put into the hoghead, and stopt up, flew up, and produced strange effects ? how often do we change the colours of things contained in Glasses in a moment ? how wonderful is it to give sight to the blind in the twinkling of an eye by couching ? how tortuous is the *meatus auditorius* made to hinder too great a noise ? Take care then, that children be not too soon exposed to too much light or noise ; for unusual things move us most. The Count of *Furstenburg* asked *Zwinger* how he could separate Iron filings from those of Brass ? he presently startled the Count with holding a Load-stone to the powders mix'd, and the Iron followed ; natural Magick then is not to be reputed Witchcraft, but the result of the natural properties of Bodies.

In *Cookery* it is also of great use, instructing to do every thing that appertains to that art ; how serviceable is *Glauber's* method of preserving meats from smelling, or of restoring them after they do smell, which is of great use to all Sailors, namely, his Spirit of Salt. He shews us out of malt and wheaten flower to make biscuits that will last uncorrupted for ever ; and Mr. *Boyle* shews us how to preserve flesh, eggs, &c. from spoiling.

In *making winy Liquors*, Chymistry lends its hand, as also in mending their faults, Vinegars, Cyders, Perrys, Elder-wine, and all others are made by this art, and the Cyder of *England* does not yield to the Wines in *France*, *Spain* or *Italy*. We seldom make any other here than Elder,

Gooseberry, or Curran-wine : Who but the Chymist teaches to preserve wines from fermenting anew, by a Sulphur match ; or to take off its acerbity by burnt lees of wine ? or to abate its acidity, by crab's-eyes or chalk ? or to take off the crudities of Rhenishes by Ceruss, which however occasions Palsies ?

In making *Ale* or *Beer* ; what has been said of wines, may be affirmed of *Beers* which Chymistry has taught us, which is so ancient, that *Tacitus* says the *Germans* made wine of corrupted barley : Thus have I shewed the use of Chymistry in most arts ; and if all artists were skilled in it, and would publish their knowledge, how great an improvement should we advance to ?

Beyond all, the Alchemists have view'd nature ; they can't create a mustard-seed, v. g. but they have applied themselves to understand the properties of Bodies ; they have observed some Bodies to have no plastick or seminal power, and therefore don't they multiply or encrease ; such are fire, water, and the earth ; as also fossiles have no seminal power, yet they receive a nourishment that propagates them ; that there is a *Spiritus Rector* in dissolv'd metals ; and a male and a female, and have shewed how to increase them ; Silver with them is the female, Gold the male ; they plac'd a prolifick virtue in fire, and taught how to get the Philosophers Stone ; they speak darkly, but plain in many places, and I have learned many things from them ; I accuse my ignorance, not their vanity ; if the study of them enriches our understandings, we gain by the bargain. Their inventions are the Philosophers Stone, by turning somewhat mercurial into Gold, an art to turn all baser Metals into Silver ; to turn Gold into the Philosophers Stone ; an art to make an universal Medicine that would render Bodies the most perfect

fect in their kind ; how to make Gems like Fossiles ; how far it is true that Quicksilver can be ripened into Gold, or one Metal transmuted into another, cannot be defin'd : *Bacon* imitated Thunder and Lightening, and *Schwarts* improved it ; who then can tell what may be done ?

Of the CHYMICAL INSTRUMENTS.

They are Gold, Fire, Mercury, Lead, Iron, Antimony, Nitre, a Smelting-pot, a Retort and Receiver, Furnaces and Bellows, Filtring-paper, Glass Eggs, and the *Atbanor* ; how can we, *v. g.* extract the whole taste of Wormwood without fire ? We refer the Instruments to fix things, *viz.* Fire, Water, Air, Earth, Menstrua, and the Tools.

Of FIRE.

It has been ador'd as a God, Chymists are called Philosophers by Fire, and its effects are so wonderful, yet its substance so inscrutable, that it may be esteemed a Spirit, and not a Body. We must entertain no speculations concerning it ; we must admit of facts, or natural Philosophy will prove greatly fallacious ; we must, like the Geometers, admit of no Hypothesis, but allow things as unknown or known as they appear by trials ; for as the elements of Fire are even in the Air itself, as well as in all other Bodies, 'tis hard to say, whether most Phenomena depend not on its action ; many errors having been entertained on its effects, let us suppose that we know nothing at all of it : We know whether fire be or be not in any place, tho' we know not its nature ; as we know not what Thunder is, but when we name it, we know what is understood by the

word. This (1) sign or word must be determined to denote one, and not many things; and this word must be so individual, as never to want its *sign*; and this sign must appear to our senses, so as to discover its increase and decrease; if these three circumstances concur, we may use the *word* Fire; and if they do, we may proceed to make experiments to discover its presence, and that we do by examining its properties: In this lies the difficulty, how to discover that a Body, the coldest of any, as ice, contains fire, where there was no sign of it, but the contrary; I find *Heat, Light, Colour, Rarefaction of Liquids, Combustion, Fusion, &c.* to denote Fire.

Wherefore let us consider these in order; *Heat* is the first property of fire, but that does not determine the quantity of fire; suppose by the reflection of a cloud, the Sun be excessively hot, then follow Thunders and Lightning, with Showers and Hail; but these don't ensue, unless a great coldness succeed this heat; yet in this cold air there is then so much heat, that if it come upon us in a frost, it would kill us; and if a chamber were so far heated in frosty weather, entering into it would destroy us.

Light is the child of Heat; 'tis said, The more light there is, the more fire there is: but heat may be without it; so Iron heated will burn,

(1) Here is a piece of Logick to little purpose. A sign is, *that which, besides the species it imprints on our senses, causes somewhat else to come into our minds*; thus the image of Cesar is a sign of Cesar, because it imprints in our eyes his image, so that we think of him; so the word *stone* is a sign of a stone, because the name *stone* is heard, and makes us think of a stone; so the word *fire* is a sign of fire, because by hearing fire named we think of fire; so heat is a sign of fire imprinted on our Bodies, and raises an idea of fire. But why this metaphysical learning in a chymical treatise?

yet

yet in the dark you shan't see it ; the rays of the Moon collected in a *lens* gave great light, but no fire appeared, by darting it upon a Thermometer, as *Hook* says ; in the focus of *Villett's* Glass there is no image of light, yet there is a fatal fire.

If fire may be without light, *colours* must not denote fire.

The more we search into its nature, the more difficulties we meet with ; if it attenuates some Bodies, it unites others, let us then see whether there be no proper sign to discover it by ; now rarefaction is a sign so proper to fire, that it may be called *proprium quarto modo, sc. omni, soli, & semper* ; and this rarefaction is generally in a reciprocal proportion to the densities of Bodies ; so that the lightest rarefy the soonest on the fire.

E X P E R I M E N T S.

Fire expands the hardest Bodies into all their dimensions, so long as it is in them ; so a Cylinder of Iron which fitted a ring when cold, won't pass through when 'tis heated, till it cools again ; take two rods of equal length, put one in the fire, it grows longer than the other, and shortens every moment, till becoming quite cold, it is of the same length with the other ; to determine this exactly (*See Plate I. Fig. 1.*) Take the body *AB* of Brass or Iron, heat it, lay it down again near the other *C. D.* and you will see the distance ; or take a Brass-Rule (*AB*) *Fig. 3.* let the base *AB* be moveable, and the *Normal B* be divided into degrees, heat it and lift it up, and the degrees on *B C* shew its difference. This dilatation is constant and general. I observe that the denser are least rarefied. I find that Glass which requires the strongest flame to melt it, is least expanded ; hence in Thermometers themselves we

must observe what sort of Glass they are made of ; I try'd one Thermometer with Quicksilver, and another filled with Alcohol, which agree, if the Glass they are made with be the same.

This expansion encreases according to the quantity of fire received into the Body ; I advise the trying the length of Iron in the coldest Winter, and the hottest Fire, and then we shall exactly know the degrees of expansion.

As soon as Iron has received the utmost heat, it expands no more ; but if by a strong Lens the fire were encreased, then would it expand more ; hence all the parts of a Body are agitated in the fire from its Centre to the Circumference, and do rarefy gradually till the Body melts ; so that all parts, even of the hardest Bodies, are changed by the softest agent, and expanded till they melt. Whether the fire divides bodies into their elements, or mixes them intimately, I know not ; but if one grain of Gold be melted with 100,000 of Silver, we find Gold in every part of this Silver.

The parts of Metals when melted, do attract each other, because they all are globular like Mercury, when the violence of the fire is removed.

Let two pieces of Metal be taken, you can never unite them till they are melted ; does fire then act on the intimate nature of Bodies ?

Who wonders then how houses newly built tremble without a puff of wind ?

Hence in the Torrid Zone, Bodies are larger and lighter ; hence *Pendulums* go slower there.

Hence is it plain, that fire relaxes all Bodies, considered as to its own action, and making humours rigid and stiff, is only an evaporation of the watry parts.

EXPERIMENT II.

Cold contracts Bodies in all their dimensions.

1. The hardest Bodies whatever are subject to this law, whether Silver, Gold or Diamonds.

2. And this Condensation encreases with the cold; and in circular Bodies they are straitned towards the centre; so that spherical Glasses being full, will run over, if they are plung'd into cold liquors.

3. We can't tell how far this Condensation would happen supposing an absolute coldness, but the absolute gravity is the same, whilst the specifick encreases.

4. The end of cold is rest, but of fire agitation of parts; Bodies are cold in their own nature; whether fire and cold act on the whole substance, or rest makes cold, or cold is when there is no fire?

5. Pendulums go faster near the Poles, because they are denser there; perhaps the heat makes the Equator higher, and cold depresses the Pole.

6. It adds strength, firmness and a stronger cohesion to Bodies; hence by meditating on Bodies, we may find, that they are compounded of minute parts united; whether these component parts can be further divided I dispute not, but they can grow much larger; thus *Democritus's* Atoms are understood.

7. The vicissitude of heat and cold causes a perpetual agitation of Bodies.

8. There is so great a Succussion of these two, that the air now hot becomes cold again; the Sun heats us in summer, we are cool'd again in winter.

9. The Sun, if it always heated us, would parch us; if 'twere always cold, all would wither.

10. Therefore God has made various seasons, that things might be always in motion.

11. We cannot determine the utmost degree of cold, nor of heat, both may be encreated far beyond our conception; how may fire be encreased by Glasses or otherwise?

12. We can only speak of comparative heat and cold; that is, as we find it with us.

13. It will be sufficient to us, if we can measure the degrees of heat and cold.

EXPERIMENT III.

The Air is expanded with the least degree of heat, as Mr. Boyle has largely proved.

This is evidently proved by *Drebbel's Thermometer*; the least breath makes the liquor ascend and descend, and it may be made so large, as to shew the least change of heat; let a large Glass *AB*, *Fig. 2. Pl. 2* have a small neck as *EF*, open at *F*; put *F* into ting'd water, heat the Ball *A, B, C, D*, the air bubbles thro' *F* into the water; abate the heat, the liquor mounts up again into the middle of *E F*, and leaps up and down as the heat abates or encreases; I like it with two Segments best, *v. Fig. 1, 2, 3. Plate 2.*

Cor. 1. The utmost expansion is indeterminable; for heat a spherical Glass till 'tis near melting, and seal it hermetically, plunge it under water, and break off its end, some air still remains in it; for it does not fill up, the air resisting its entrance, till by degrees the air mingles and exhales; so that the fire rarefies the air, but does not quite expel it.

Cor. 2. A great heat rarefies Iron but little, but a little one expands the air vastly.

Cor. 3. Increase the segments of *Drebbel's Thermometer*, and make the Tube strait and long, and
you

you may nicely distinguish any minute difference of rarefaction.

Cor. 4. The greatest degree of natural heat in the air, rarely reaches 90 degrees in *Farenheit's* Thermometer, but *Drebbel's* is easy and useful, if at the same time we mind the air's weight by the Barometer, for so you nicely discover the minutest increases of it.

Cor. 5. It is plain then, that the air is always moving, whether unconfin'd or shut up, since its rarefaction and weight are always varying.

E X P E R I M E N T IV.

The air contracts by cold in all its parts, as appears whenever heat is removed.

Cor. 1. 'Tis impossible to determine the *ultimum minimum* of the air's Condensation, because we can't banish fire entirely.

Cor. 2. The least decrease of heat condenses the air more than the intensest cold; hence the air discovers the degree of fire.

Cor. 3. Hence every the least decrease of fire, or increase of cold, may be made visible.

Cor. 4. Hence the use of the aerial Thermometer will appear both by freezing mixtures and the winter's cold; in *Iceland* 1709 the liquor stood at 1, and 1730 at 5 in our physick garden; and by freezing compositions, Salt-armoniac put into a glass along with Salt, and cork'd up, were put into water and expos'd all night, the Thermometer was then at 53° above 0; I put in fresh powder of Salt-armoniack, and stirr'd, the Glass settled presently to 25; the degree of heat was then 51; Salt-armoniac then, one to three of water, made the cold encrease 28 degrees: The cooler the air is, the easier it is to freeze Bodies; at 32° it is easy, not so at 60°; when water is brought

to be so cold as to settle the Glass to 32, more Salt-armoniac settles it 4°; and by still adding more to it, we at last freeze it, and create a greater coldness than our country ever afforded. 'Tis difficult to determine the point of freezing, but if we hang a Thermometer, so as to touch nothing, I observe a wet cloth exposed grows stiff, when the Glass stands at 33°.

A Hoar is a beginning frost, and is first observed on bridges, which hang in the air and touch nothing, and therefore do best shew the temperature of the air; and as the frost begins there, it also thaws there first; other Bodies freeze not till they are thoroughly cooled.

The greatest cold, produced naturally, settles the Glass to 0°; and artificially produced to 4° or 3°, but *Farenheit*, in 1729, wrote me somewhat wonderful, to wit, that Spirit of Nitre which was to water as 1409 to 1000 warm to 48, being poured upon powder'd ice, settled the Glass to 4 under 0°; and a mercurial instead of alcoholick Glass, it settled from 16 above 0 to 14 under it, and by pouring the old out, and adding fresh to 29, and even at last to 40 under 0; Spirit of Salt cold to 17° poured on powder'd ice, settled the Glass to 8 below 0, and by pouring out that, and putting in more to the remaining ice to 14½ below 0; nay, Pot-ashes mixed with the ice, settled the Glass to 8 below 0; Mercury in this Glass then was reduced to a bulk very small, so as to approach near to Gold, since from 40 below 0, to 600° when it boils it must suffer a Condensation equal to 640 of 10782, or 69½ of its bulk: And how far cold can contract Bodies can't be defin'd.

Cor. 5. The air, free or shut up, is never at rest.

E X P E R I M E N T V.

Rectified Spirit of Wine expands in its whole bulk every where, as appears in a Glass Bubble containing 1933 parts, ending in a Cylinder that contained 96 parts; this Glass in the cold place of the earth to $N^{\circ} 1^{\circ}$, and with a warm hand it expands to 96.

Cor. 1. Supposing the capacity of the Glass continued the same (for surely it was dilated) the liquor expanded to $\frac{1}{20}$ part of its bulk.

Cor. 2. If the contraction of the Glass by the utmost cold, and its dilatation by the heat of the hand were known, then the expansion might be nicely known.

Cor. 3. How does this weight differ at the Poles and the Equator? hence again we prove the earth spheroidal.

Cor. 4. Vessels that are not full in Winter, will be full in Summer; hence never fill your bottles quite full in Winter, lest they burst in Summer.

Cor. 5. If Spirit of Wine be near boiling, it rarefies to 174 parts in the Glass, that is $\frac{1}{11}$ part more than naturally; buying things then in Summer, makes great difference; so if it settle 40° below 0, and rise to 174° above it, that is 214 in 1933, that is, it contracts and expands to $\frac{1}{9}$ of the whole bulk.

Cor. 6. If the Spirit boil, you cannot observe its degree of rarefaction.

Cor. 7. Spirit of Wine never rests in the same state, but is always, open or shut up, condensing and rarefying, and the same happens to it in our vessels.

E X P E-

E X P E R I M E N T VI.

The etherial Oil of Turpentine is expanded every way by the least heat.

If Oil of Turpentine be put into water, this plainly appears, for it rises as the water heats; and when the water boils, the oil rises no higher, encrease the fire to what degree you please; for once water boils it can be no hotter; however the heat of boiling water encreases as the air is heavier, and *vice versa*; thus *Monf. des Amonton* and *Farenheit*. From hence is it, that the heat of the Sun is greater when the air is heaviest on the surface of the earth, *v. g.* and least when it is less, as on mountains, &c. Thus heated water boils in the exhausted receiver sooner. In *Papin's* digester let water boil, the water expands to $\frac{1}{85}$, and air to $\frac{1}{3}$; the water is 30° hotter from the pressure only; oil at 52° , when boiling at 212° . *v. Cor. 2. Exp. 5.* Alcohol boils sooner and oil of turpentine later than water, tho' lighter, either from some affinity, weight or tenacity.

E X P E R I M E N T VII.

Rain-water heated gradually, rarefies gradually; for it rises from 56° to 212° , and then it boils.

E X P E R I M E N T VIII.

Quicksilver easily rarefies with heat; it rises to 212° in *Farenheit's* Thermometer.

Cor. 1. A Lixivium of Sea-salt, Salt-petre, fix'd Salts, all Liquors, Air, Oils, Water, Saline Spirit, Oil of Vitriol and Mercury, are all subject to this law.

Cor. 2. This cause passes thro' all vessels.

Cor. 3. This cause is heat or fire.

S C H O-

SCHOLIUM.

This cause where-ever it is, has two properties, to wit, it penetrates and dilates.

EXPERIMENT IX.

Put one piece of Iron upon another, rub them together, they grow hot, sparkle and become fire.

Cor. 1. This experiment answers in all weathers, and soonest *cæteris paribus* in cold weather.

Cor. 2. It answers also in all places, but soonest in dry places.

Cor. 3. In *Vacuum* Bodies by attrition grow hot, as *Hawkesby* and *Gravesande* shew.

Cor. 4. Fire produced this way does, as all other fire does, *viz.* penetrates, heats, expands, burns, &c.

Cor. 5. The harder bodies are that are rubbed together, the sooner do they fire, and the greater is the heat; the softer the bodies are, the longer ere they take fire, if they do at all: Iron cool'd in Summers Air is softer than when dipp'd in water; thus the axle-tree of a mill, if greas'd or lin'd with Lead, won't fire. A Hone oil'd won't fire with the razor, but will heat if rubb'd together; the hardest and densest Bodies then fire the soonest; this even holds in wood, as appears in the *Sideroxylon* (Iron-wood) of the *Indians*, which serves them for Arms, and fire also by attrition. This holds in Steel and Flint.

Cor. 6. The weight alone of two pieces of Iron laid upon each other produces no heat; but the greater the weight and the velocity of attrition are, the sooner is fire kindled; a small velocity of attrition produces only a warmth, but a brisk motion added to the weight, soon fires.

Cor. 7. A

Cor. 7. A slow motion of a rope does not heat the hand, but draw it through with force, and it will burn; so a file with Iron strongly mov'd backward and forwards, heats, so does a knife on a hone; velocity then produces the fire.

Cor. 8. Hence if weight, hardness and velocity concur, fire may be encreased infinitely.

E X P E R I M E N T X.

If any Liquid be interposed between two surfaces, little or no heat ensues; put a little oil between the razor and whetstone it never heats, which without that it wou'd; the same in Mills greas'd; so happens it in grinding Glafs with oil or water.

Cor. 1. Hence smooth and soft Bodies are unapt to heat.

Cor. 2. The less Bodies are pressed together in rubbing, the less heat is produced.

Cor. 3. If other properties concur, but strong friction be wanting, there is no heat.

Cor. 4. Hence if there be large spaces in Bodies, and they cohere slenderly, fire is not made sensible to us. *2dly*, Or if there be no friction. *3dly*, Or if no other cause concur to make motion in the spaces: In the *vacuum* at the top of the Barometer such is the case. Shake this Tube in the dark, light (which is a sign of fire) appears, but no heat: At the tops of high mountains Snows lie all the year; the higher then, the less motion is there, and less heat. The Alchymists have said, that in pure fire there is silence, rest, and God dwells there; so said the *Hebræans*, *Exod. iii. Ps. civ. Epist. to the Heb. i. 12.*

Cor. 5. The sudden heat of Metals appears by various examples; so a bullet thrown 600 feet in a second, which motion is more rapid than a storm, when it falls, is very hot, which depends
on

on the friction of the air, not the powder. This confirms what is said above: So that altho' the Weather-glass with Spirit settle to o, yet there is heat in the air.

If you expose Bodies of all kinds, Metals, Oils, Spirits, &c. to the air, they are equally cool, and if you apply the Thermometer to them, and the *vacuum* of the Barometer, you will find them all equally hot.

I could never discover any space void of fire, and 'tis equally dispersed thro' all Bodies, unless causes concur; I never found any magnet for fire, to unite, in any centre: However Iron may feel to us cooler than Feathers, it is not so in fact.

When all things keep their forms and shapes, and heat is equally distributed every where, nobody thinks of heat; but when, v. g. wax melts, then fire appears.

Where-ever fire is, there is motion, how little soever it appears to us; who is he that can assign absolute cold, or a perfect rest in fire? If ever fire encreases, it rarefies; there is a principle in Bodies of attraction and of repulsion; Bodies would stronglier attract each other, if fire did not hinder. This is seen in Quicksilver settling and contracting itself in Winter, and dilating in Summer; the first is caused by its attractive force removing all heat, the latter by the repelling and rarefying force of heat.

Fire does not penetrate Bodies, it only enters the pores, for Bodies are impenetrable; this *impenetrability* is called *Αντιρρησία* Democriti.

So long as fire lodges in these pores, and has a free entrance and egress, no effects are observ'd; the puff of a pair of bellows don't settle the Thermometer, therefore neither heat or cold are increased by this wind, for this don't disturb the air; but if the whole air were disturb'd, then
heat

heat would ensue ; why then does this blast cool us ? Don't we find cold so troublesome as to cause gangrenes ? But the case is otherwise, nobody can live in air heated to 90 degrees, but our own heat is equal to 92, and in children to 94 ; hence we are always hotter than the air ; hence our cloaths are warmer than if exposed to the air, and we warm the air around us ; if the air then is calm, we are warmer than it ; and if a cold air comes, we grow cold ; the air and our cloaths are cool'd, as if we put on cold ; so that tho' the wind don't produce cold, yet it cools us : This remark is of use in physick ; for let a person be hot to 100 degrees, the air be 48° hot, the cloaths will be hot as 100 ; and the air near us hotter than to 48° ; for a man entering alters the Thermometer, which settles again upon his retiring ; let the air in this supposition be 60° , then our body is surrounded with this temperature of the air ; if the body be exposed to a wind that moves 6 foot in a second, then all the warmth of our cloaths will be reduced to 48° , then we grow cooler by 12 ; and if this continues, we grow cooler every moment ; hence does the reason of this Phænomenon appear.

Let therefore any wind ever so strong blow, if no other cause concur, the Thermometer never alters ; if then, we being over-heated, expose ourselves suddenly to the air, or if weakly persons overheated in their chambers, let in a colder air suddenly at a chink, what mischiefs don't ensue ? Asthmas, Pleurifies, &c.

We may now contemplate on the nature and action of fire ; if two hard and heavy Bodies are rubbed together with great celerity, there arises a vibration, *sc.* Contraction and expansion, as in musical strings and bells, thro' the whole mass, and all its component parts, from whence all the
noise

noise arises ; and as all this arises from attrition and agitation of the most elastick body, wherever that is, fire will appear ; where it is not, there the body is all over of the same heat ; wherever attrition is increased, the fire increases.

Why do elasticks only produce fire ? because they only vibrate : Why do the most elastick Bodies fire the most ? because their vibrations are swiftest : Why do soft and non-elastick Bodies produce less fire ? because they don't vibrate : Why does lead heat upon attrition ? because its component parts are elastick, altho' the compound is not. Don't fluids generate heat ? yes, if elastick, hardly otherwise ; waters hardly heat, yet as their elements are elastick, they heat by violent motion : if the tubes they are conveyed thro' be elastick, they heat the sooner ; but if the tubes and liquors are elastick too, they heat and continue hot ; this is the case of the blood, which the more watery, the less hot is it. Why is heat hindered by the intervention of a liquid ? because soft Bodies elude friction. Does elasticity then augment heat ? yes, greatly. If attraction did not determine Bodies to contract, what would become of fire ? then fire would not appear, as in mountains and mines. What happens in deep fountains, where the air is at rest ? there the heat is always equal, as is confirmed in the observatory at *Paris*. Why does Flint and Steel give the liveliest sparks in Winter ? Gravity, Elasticity and Fire are three universal things, or common causes of actions in Bodies, to which if you add attrition, this question is answered.

Bodies the heaviest at the centre of the earth, rubb'd strongly together, would raise a strong fire ; hence it is, that this appearance is greatest at the centre, and least betwixt any Star and the Earth,

Earth, because fire is least where there is no resistance.

If the pores of a Body are so large as to admit Oil, Spirits, &c. then these Bodies don't heat, but if they are so strait as to admit nothing but fire, then they heat; or if two Bodies are polish'd and fitted, or if they are agitated so quickly that nothing can enter but fire, or if the elements of a Body are elastick and strongly knit together; in all these cases, fire will take place.

I have often thought whether any Bodies attracted fire more than others, and I only find that rarer Bodies take fire soonest, and densest are longer in cooling.

Percussion attracts fire, and makes Iron hot so as to fire Brimstone, because this force shakes the inmost parts of the Body, and raises a tremulous motion in them.

This heat is only raised by compression, attrition and vibration.

'Tis elasticity that causes these vibrations, and their continuance.

It may be asked whether the fire rais'd pre-existed in the Body; I say it does, and 'tis only percussion that makes it more evident and active.

It appears then, that in the utmost known cold, fire resides, which penetrates all things, and expands all things but space.

E X P E R I M E N T' XI.

Fire known by its rarefactive, motive, and penetrating power, collected in any space, moves and expands itself every way from the centre of that space or body: As a proof of this, a lead or bullet plung'd into warm water, till it is as hot as it, and a red-hot poker, move the Thermometer

mometer equally with the water and fire they were heated in, each at the same distance.

Cor. 1. Hence fire tends to all points indifferently ; a little sphere (of fire) placed in the centre of a larger, expands it self around, so does it in the air (*m*) and this idea differs little from the idea of rest.

Cor. 2. Let a small Globe of air *A*, *Pl. 3. Fig. 1.* be hotter than that in *B*, then I say that the expansive force will be as the spaces of the parts placed around, to the whole circumscrib'd space.

Cor. 3. Suppose a circle *A*, *Pl. 3. Fig. 2.* full of fire, touch'd by another *B*, draw Tangents *CD, CE*, to *B* from *A* ; it is plain then, that the fire of *A* can't come to *B* but from the Sector *FG*, whose geometrical proportion to the whole Globe *A* is easily found, as also the magnitude of the Cone *C, D, E* ; and of the Segment *D, I, E* ; hence the quantity communicated may be had.

Suppose then by any physical cause, all the fire in this sphere should be driven directly in parallel lines towards another part, its whole force will be so united, as that it will pass from the Cylinder, *Pl. 3. Fig. 3. E, F, G, I*, to the Globe *K, G, I, B* intirely ; so that the latter will be to the former, as the whole to a part, and as the parallel direction to the diverging one ; but from the effect of combin'd causes, there will be produced a force greater than the former. But the force of the fire augmented to double, increases the efficacy prodigiously ; for at 32° it freezes, at 64° the air

(*m*) Pray where do you place the fire but in the centre ? And are not all qualities whatever intended or remitted in a reciprocal duplicate proportion from the radiating point ? What is the Sun, but this point from whence all heat is dispers'd ? They then who are twice as near the Sun as we are, will be four times hotter, *ceteris paribus*.

is very hot ; at 96° the air is fatal to animals ; at 216° , that is when 'tis hotter than boiling water, it destroys all animals. Since then the air of the greatest circle in this sphere is to the whole surface of the same as 1 to 4 ; the fire in the Base of the said Cylinder being four times compacter, than in the surface of the sphere, hence the fire will be more united and increased. If then it could be accurately known, how much the force of the fire to be expanded is increased, in proportion to the lesser spaces into which it is condens'd, the rest may be had. Suppose it were as the area's, the force would be quadruply greater from the quantity ; quadruply greater from the expansion ; and therefore it would be sixteen times greater from both. We should try then by experiments, whether the expansive force of the fire with respect to its density could be determined. It is likely that this is very great in the fire ; and therefore this parallel direction is the greatest.

EXPERIMENT XII.

The Sun (1343 greater than the earth, and distant from us 12543 diameters of the same) darts its rays in a parallel direction, as all know, if nothing hinders it ; and from the point of inflexion the rays run parallel again ; this experiment proves it : In a fine winter's night at midnight, the Moon and all the Stars are lighted, nothing but the space of the earth is shadowed ; let the Sun's rays in at a hole in a darkened chamber, the light is not seen but within the cone of rays.

This is confirm'd, because the Sun's rays fall directly on Bodies as it rises and sets ; so does it when reflected from Glasses ; and in Optics 'tis taught, that

that the rays of the Sun falling directly upon a Glass, are reflected in a direct line to another; and in this supposition their *Calculus* answers so accurately, that the Phænomena answer to their demonstrations.

This parallelism causes heat in Bodies, and so it is whether we speak of heat or fire; so that this direction increases the expansive force without any emission of fire from the body of the Sun.

But you will say, Why then does not a candle heat a place? I answer, Because it is diffused around, and unless you hold a body near it, this direction is lost.

Cor. 1. As soon as this direction ceases, the fire and heat cease; for then the rays are darted equally round, and if you put any body between the Sun and *Villett's* Focus, no heat ensues.

The windows of *bot-houses* for plants should be made to the south; they should be erected from the pavement to an angle of $14^{\circ} 30'$, and the ceiling in the latitude of $52^{\circ} \frac{1}{2}$ should be so made, as to decline from a horizontal line from the windows drawn from the height of the lights towards the back wall, about an angle of $20^{\circ} 30'$; for if the ceilings are not illuminated, the place is cold, and perishes the plants (*n*).

Cor. 2. The heat produced by the Sun any where is much less than our native heat; for our heat mounts the Thermometer to 92° , but the Sun's only to 48° . I speak of heat without reflexion; for clouds reflect greatly, but never so as to set fire to Alcohol, Gunpowder, Sulphur, &c. I abstract from lightening: So that attrition produces greater heat than the Sun; we can't say

(*n*) As to the construction of winter or hot-houses, consult Gardeners.

'tis hot because it is sun-shine ; for Iron will fire Gunpowder, though it don't shine ; heat and light may be separated.

Cor. 3. The Sun's heat therefore never destroys any, unless by reflexion, as at *Ormuz* it sometimes happens from the mountains of white-salt.

Cor. 4. If the Sun should shine at a time when all things are disposed to an equal transmission of its rays, then would it act in parallel lines, but that seldom happens ; hence its vicissitudes of heat and cold.

Cor. 5. Hence heat is seldom found the same in different places, by reason of these impediments of equal transmission.

E X P E R I M E N T XIII.

If the heat of the Sun falls upon black colours, they retain the heat longest ; they sooner heat, and sooner dry, when wetted ; the more bright colours are, the more they reflect the light, and heat less ; hence white are best to wear in hot countries ; white heat least, but dry latest. I have long known that black Bodies burn soonest ; all natural history confirms that white wood, linnen, paper, white-earth, burn slowly, but the blacks very quickly ; this is true, if Gunpowder, &c. and black clouds breed thunder (o).

E X P E R I M E N T XIV.

Black things do not reflect a fiery heat ; so smoak any burning-glass, even *Tschirnbaue's*, and it burns nothing ; blacks are privations of colours, blacks are best for sore eyes ; how small a matter then hinders the Sun's heat ! any black crust hinders it, whereas white things reflect the heat strongly, as a speculum of Silver, or Glass silvered behind. Gold reflects

reflects strongly, so does wood hollowed accurately; nay, even a speculum made of Straw finely wrought, burns strongly; other colours may be tryed according to *Newton's* stated laws of colours.

Cor. 1. The colours of Glasses make the fire stronger or weaker.

Cor. 2. We may know what effect heat will have upon Bodies; black earth burns the feet, and spares the eyes, and the white earth cools the feet and hurts the eyes; umbrells may be made warm or cool, so may houses, huts, &c.

Cor. 3. The Sun is hottest where the earth is black; and in *Ormus* and *Gamron*, the white mountains make it impossible to live but under water all but the head (*p*).

Cor. 4. The fire makes water to mount into the air, and the lighter the air is, the easier it rises; when it is come high into the air, it condenses into clouds, which reflect the Sun, and make the air hot; if the clouds are black it breeds Thunder.

Cor. 5. We see then the reasons of the sudden vicissitudes of heat and cold; where-ever the Sun's rays are parallel, it is hot, and *vice versa*.

EXPERIMENT XV.

Suppose the Sun's rays were received upon a white body finely polished, and so reflected from it as to be all united into a point, then would fire be all collected into that point.

So much stronger will the rays be in this point or focus from their quantity united, as the place uniting these rays is less than the sum of the space of the surfaces of the reflecting Bodies.

If by art, a parabolick Speculum could be made, dense as Gold, white as Quicksilver, and

E 3

elastick

(b) Hence dangerous fevers happen to our sailors.

elastick as Steel, and the open of the basis large, the whole force of the fire would be united in a point.

Or if the speculum were made spherical, of solid, white, hard, elastick matter, without rasures, the fire would be very violent.

To mention no other, I shall only speak of *Villett's* Glass of *Lyons*; who made a Glass of a certain mixture of metals, which is concave on one side, and convex on the other; its diameter is 40 inches over, and therefore its area is $1452 \frac{11}{14}$ inches, when the rays are admitted; 'tis finely polished on both sides; it weighs 400 lb. *French*; the rays are collected into half an inch; its focus is $3 \frac{1}{2}$ feet distant: So that the rays are collected from 7369 of a circle into one; hence in the focus there will be 7369 times more fire here, than in the air from the Sun.

This difference is great; but I have suppos'd all the rays to be reflected, which is not true; for there are rasures to be seen by looking obliquely on the Glass, which distort many rays; so that this computation must be abated: In the focus of this Glass branches of green wood flam'd immediately, metals and semi-metals melt in an instant, bricks and every thing melt instantly into Glass.

The cooler is this speculum, the sooner it burns; so that its effect is stronger in winter; heat widens the pores of it, and lessens its elasticity. It being exposed to the Moon at full, gave a vast light, but no heat to the Thermometer, and yet it burns vehemently all things when expos'd to the Sun; therefore fire and light differ: This disadvantage attends it, that you can't hinder the melted Bodies from falling down, and you are hindred thereby from farther tryals on them; however

however it is so finely polished, that it reflects better than Glass quicksilver'd.

Cor. 1. The Sun only gives heat and not the Planets ; they may give light, but nothing besides ; so that astrology is vain and ridiculous from heat.

Cor. 2. Whatever changes we suffer from the fix'd stars or others, must depend upon gravity, or attractions and repelling forces, which are not determinable.

Cor. 3. We may pronounce on Phænomena, to wit, water is snatched up into the air, it mounts high, as the clearness of the weather and the air's weight prove ; it freezes there, appears in clouds : From the Sun's reflexion greater light is produced, sometimes darkness ; when they shine, it is a sign of frost or snow ; in hot weather they mount high, fly about, and are white, and presently they grow heavy, dark, and full of rain ; if it falls in great drops as in summer, it is a sign the clouds were hail thaw'd ; the higher clouds fly, the more their matter cools, and even freezes ; and the fiercer is their fall, from their altitude which accelerates their fall ; hence a small cloud on high in *Asia* falling, makes the *Ox-eye* or Whirlwind ; white clouds are snow, and the Sun reflected from them heats ; the part they shade must be cold, because the earth is shaded ; it can't then, Gentlemen, be any surprize to see the various changes of seasons, how great heats are succeeded by great storms ; for suppose the clouds reflect the Sun, there must be a reflecting speculum ; this being inverted, great cold and storms arise, if by the force of gravity air runs into the Barometer at the rate of 22 or 23 feet in a second ; what may not happen by such specula ? And thus may all vicissitudes be understood.

Cor. 4. Hence thunders, storms and the like happen after frost, because the vapours are lifted up into the air by the succeeding thaw and heat.

Cor. 5. The rays of the Sun reflected from the ground, houses or mountains, in some places do raise heat; colours do also change the heat, so do seasons of the year; hence heat differs according to those circumstances, some morning, some evening Suns are warmest; let us examine these things, which may vary according to the reflexion; hence valleys are hotter than plains; cattle are cool in heaths, for they are thorow-blown, unless from reflecting clouds it should chance to be hot; hence heat is equal every where at like distance, if no other cause concur.

Cor. 6. One word more; meteors owe their rise to various reflexions of the Sun's parallelism.

Cor. 7. It would be of use, if we knew the proportion betwixt the quantity of inciding and reflected light; light falling from a diameter of two feet on a spherical concave, and reflected into a focus of an inch diameter, the magnitudes of this area and focus collecting the rays are in a duplicate *ratio* of the diameters; hence rays inciding to reflected rays are in that proportion; but others who considered things physically were puzzled to know this problem.

A great many rays that should be reflected, are drowned in the pores of the reflecting body; for no matter yet used can be free of rasures, because nothing heavier than steel has yet been used for that purpose.

Suppose you could make your speculum spherical and solid, it would appear black every where but in the focus; but you can't polish without rasures, as you may see by a microscope.

But

But suppose we get over this difficulty of polishing, light is so heterogeneous, that some rays might not, nor could they be reflected; so that you only can reckon the quantity of them, but know not what to subduct.

It is a question, whether the force of fire be as its quantity, so as a double quantity acts with a double force; for we know that a greater quantity in a less space, acts infinitely more than when dispers'd; Bodies at a distance beyond their sphere of activity, act not at all as Loadstones, which act, as Sir *Isaac Newton* suspects, in a triplicate reciprocal ratio of their distances, which Mr. *Musschenbroeck* Professor at *Utrecht*, labours hard to ascertain.

Suppose many Loadstones plac'd within the sphere of one, they will all move; but if one be plac'd in the centre of this sphere of attraction, how do they move, and faster as they approach? so fire collected becomes more violent; *Villett's speculum* burns all in its focus, but five inches from the focus a Thermometer is not heated to 190° ; condensation therefore, or agglomeration raises all these agitations.

It is not yet known, whether the reflecting force, where the parts of the speculum make the rays red hot, be equally strong at the axis where they incide, as about the upper part of the speculum, and therefore it may be doubted, whether all the rays reflected and uniting in the focus, do so unite, as that the force united answers to the number of rays collected.

By covering any part of the speculum, we can intercept any number of rays, and so lessen their force; hence if we cover half, we may compute how far the force is lessened, and whether that depends on the number of rays or any other law.

Cor. 8. Suppose we cover the Glass, so as to boil water only, and then open it so as to make the Mercury ascend to 424° , then there would be a double heat; by such comparisons we may encrease the fire infinitely, or lessen it, and compute the aperture of the Glass. Fire differs from Cold only by the action of a resisting body.

Cor. 9. The greatest heat possible vitrifies Bodies; this appears in *Villett's* speculum vitrifying flints, &c. but this is done by striking fire with a flint and a steel, the sparks are flint vitrified into globules, as you may see if you catch the sparks on paper (*q*).

E X P E R I M E N T XVI.

The rays of the Sun received on a spherical speculum, and collected into a focus, do burn violently. This is evident in *Tschirnhauser's* spherical Glass, 4 feet in diameter, convex on both sides, exposed to a clear Sun at 9 or 10 in the morning, till 3 in the afternoon, the focus was 12 feet from the Glass of half an inch. It burns all combustibles, and vitrifies.

Cor. 1. The diameter of *Villett's* Glass is 43 inches; its circumference then is $9\frac{46}{7}$; of *Tschirnhauser's* is 48 inches, its circumference is $10\frac{56}{7}$; the inciding rays of the latter to the former's, are as 2304 to 1849, and yet *Villett's* is stronger much.

Cor. 2. Hence it is plain, that *reflexion* does preserve the rays more untouch'd than *refraction*, by which many of them are lost.

Cor. 3. *Villette's* is $406\frac{78}{28}$ square inches; its focus is $79\frac{2}{8}$ square lines; the area of *Tschirnhauser's* is $506\frac{88}{28}$ square inches, and its focus is $71\frac{28}{28}$ square lines; so that the focus of the speculum to that of the Glass is 1 to 4; hence is *reflexion* stronger

stronger than refraction, and opac specula are better than transparent Glasses; besides the opac specula may be made larger, the others hardly. Pity it is Princes don't encourage artificers to proceed further.

E X P E R I M E N T XVII.

Tschirnhaufe made a Lens of a less Segment, to receive all the rays, and to communicate them to the former; he reduc'd the rays from 8 square lines to 16. It burnt more than the former, but many rays were lost. I shall recite to you its effects, to shew you that gross fire is not required to do more than suffices to chymical purposes.

1. Wet branches were consumed into flames, and into ashes in an instant.
2. Water boiled instantaneously; I wish this had been try'd with *Fahrenheit's* Thermometer of mercury, to have known whether it would have made water hotter than common fires.
3. Thin metallick plates melted gradually, but solid pieces slowly.
4. Brick and Talc grew red in an instant, and then vitrified.
5. Sulphur, pitch, rosin, melted under water.
6. Wood in water seem'd outwardly sound, but tried, was a coal.
7. If the matter was on any black basis, the heat was greatly increased.
8. If the substances are plac'd on charcoal made from green wood, they sparkle and fly away; Lead and Tin soon vitrify.
9. Ashes of vegetables vitrify quickly.
10. Great things don't melt soon, but powders quickly.
11. Black things change presently, but not white ones, or such as become so; so chalk, lime, flints don't change.
12. Metals on porcelain vitrify soon, so it be heated moderately, and be so thick itself as not to melt.
13. If the matter be plac'd in a Glass-jar, so as the rays fall on the body, and not on the Glass, there

there are strange phænomena. 14. Nitre exhales instantly into spirit, which our fires can't do without earth mix'd, or oil of vitriol. 15. The Moon's rays give light but not heat. 16. It moves all Bodies even *in vacuo*. This Glass therefore is weaker than *Villette's*, but is fitter for trying fire by its effects.

Cor. 1. Water in the atmosphere, or little pieces of ice gathered into globes, as they are greater or less, and transmitting the Sun, may produce more wonderful effects than this Glass.

Cor. 2. I must remind you how the steel and flint do assoon vitrify Bodies as these Glasses, barely by attrition.

Cor. 3. There needs no Sun then, nor inflammable matter to produce the utmost effects of fire, as melting metals, &c.

Cor. 4. The Sun does not afford fire, 'tis only the direction of its rays that raises the latent fire of the body; a veil drawn before a Thermometer, or *Villette's speculum*, there's no rising of the spirit or mercury, nor any burning; draw aside the veil, and the one rises whilst the other burns vehemently.

Cor. 5. The greatest heat possible would be, if the foci of the speculum, and the glass named should so be ordered, as to fall upon the body at once, in a diametrical opposition; clouds may act so.

Cor. 6. This heat might remain, so long as these circumstances continued, and yet no pabulum afforded.

Cor. 7. Remove this circumstance, the fire, the light, heat, and all effects cease in a moment.

Cor. 8. Fire seems then to consist in the physical power of expanding itself around equally, and where that power resides, there is fire; where it is wanting, there's no fire.

E X P E-

EXPERIMENT XVIII.

True fire can be joined to every solid, and reside there long enough, nor does it perish as in the aforesaid fire. All Bodies exposed to fire shine and melt; this is well known; water itself, if it should be turned into earth, would shine when on fire; hence some cause must detain the fire; for that from the specula fires nothing, if it is only in the air, but perishes; but if it fall upon an iron globe, till it is set on fire, it remains, because there it falls on a solid matter (*r*).

EXPERIMENT XIX.

This elemental fire is true fire; for the Thermometer rises by the heat of hot Iron, and settles upon its removal, as you approach or retire (*s*); sulphur held to the red hot poker, as you approach it smoaks, and at last flames; and gunpowder, wood and other bodies flame with it; but alcohol exhales without flaming, which is strange.

EXPERIMENT XX.

Weight is not what sticks to the body, for Iron and Brass weighed the same when red hot, as when cold in the scales, made with metallick

(*r*) Where is the wonder, that the force impress'd on Bodies should continue, altho' the agent ceased to act? That a stone should go forward in the same direction it was thrown, altho' the person who threw it, should die the instant he delivered it? Or that a burning-glass should light a pipe of tobacco? Or that the air should disperse the fire it receives?

(*s*) Because qualities are in a *ratio* of their distance from the radiating point.

chains,

chains, lest the moisture of the ropes might lessen the weight (*t*).

Cor. 1. Fire forms a circle around it of heat, which heats as we approach it (*u*).

Cor. 2. The greatest heat is in the centre of this circle or this body.

Cor. 3. It decreases as you retire from the centre of this body ; and it vibrates all the time the fire lasts there, till it quite flies off.

Cor. 4. We can only guess at the proportion of fire by its effects ; and since we know not the proportion of its power from its condensation in respect of that from its quantity, so long we dare not argue concerning its quantity from its effects.

Cor. 5. Fire does not concrete into any corporeal mass, tho' it encreases the bulk, not so the weight.

Cor. 6. It does not lessen the weight of Bodies.

Cor. 7. It is under the form of a third thing in Bodies.

Cor. 8. There must be some cause that detains it from dispersing.

Cor. 9. Body is what retains heat, and the denser bodies are, the longer do they keep hot ; so air loses heat presently ; gold keeps longest hot : That body which is hottest retains its heat longest, the matter being the same ; oil and water boiled retain their heat according to their *pondus*,

(*t*) Pray what weight can we perceive may be added to a heated body by the particles of fire in five Pounds ? A parallelo-piped weighing five Pound, would not take up more space than $\frac{1}{16}$ of a grain of air ; and fire being lighter than air by a considerable degree, where will you find a scale that will shew us so nice a difference ?

(*u*) Qualities are intended and remitted in an inverse duplicate ratio of the distances, twice as near, four times as hot ; four times nearer, sixteen times hotter. *Keill. Introd.*

nor does oil keep it longer for its tenacity. Fire gives to every body only a certain degree of heat; but when a light body boils later, it receives more than a heavier; water is heavier than linseed-oil: Water has 213 degrees of heat when it boils, and then it can grow no hotter; the oil which is lighter requires 600° before it boils; Quicksilver which is 15 times heavier than this oil, requires no more fire to make it boil than the oil; so that the *pondus* alone is not the reason of their boiling sooner or later. Water then may extinguish fire, since combustibles never burn with only 213 degrees of heat. Tin and lead melt before oil boils, but not so with water in them. Hence when fire passes freely thro' a body, so as to make it boil or melt, that body can receive no more heat. To sum up all this Corollary, a greater heat lasts longer, a denser body retains heat longer; that heat sticks longer in oily bodies, and that they therefore contain heat in proportion more than others that boil sooner; that the denser, the more fire they require before they grow hot with a rarer body, and therefore require a longer time to cool. We may at length by experiments be able to solve these problems, *To fill a given space with such a body, as it may grow hot to a determin'd degree with the greatest fire, and, to fill a given space with such a body, as the greatest fire possible may be retained in it.* 'Tis worth enquiry, whether Iron, being slower in melting than Gold, when it is melted, is not hotter than Gold when melted, altho' denser (x).

Cor. 10. The hotter Bodies are, the sooner they cool with applying a cold Body to them; and

(x) This is opposite to Sir Isaac Newton and himself else where.

the denser is the Body into which they are plunged, they cool the sooner, v. g. much sooner in quicksilver than in water, in water than in air, in certain proportions; to soften Iron extinguish it amongst the warm ashes, to harden it in water.

Three causes concur to cool Bodies, coldness, density, and stirring the body in fresh cool liquors; so Iron hardens in cold water.

Cor. 11. The reason why denser Bodies cool heated Bodies soonest, is, *The distribution of the fire is as the bulk*; so that if there be lbj of water boiled and another lbj of cold water, the first has 212° of heat, the latter only 32, then $212 - 32 = 180$, and $180^{\circ} \div 2 = 90^{\circ}$ so that the heat will mount the Thermometer only to 90° ; hence the common degree of heat (30) vanishes, and the excess is halved; but if you mix boiling water with quicksilver, there is a greater difference; for if the water was hotter than the quicksilver, if equal bulks were mixed, then the temperature was hotter than half (as in water with water;) on the contrary, if the quicksilver was hotter than the water, the temperature was cooler than half the difference; and the diversity was such, as if three parts of hot water were mix'd with two of cold; or in the latter case, as if three parts of cold water were mix'd with two of hot; but if you take three bulks of mercury equal in extension, and two such of water, then it is equal whether you heat the quicksilver or the water, there will then arise a temperature equal to half the difference, as at first was said of the water: So that altho' quicksilver were to water as 20 to 1, yet the heat measured would be equal, if the bulks be so. These were *Fahrenheit's* experiments.

Cor. 12.

Cor. 12. Heat decays last of all at the centre ; hence how long would a great and dense Globe be a cooling ?

Cor. 13. The denser the body, the less is its surface ; the less the surface, the longer do they retain heat ; and as spheres are of the least surface of all bodies of equal perimeters, they retain heat the longest.

Cor. 14. And as bodies become of greater surfaces as they are divided, as in a sphere into many, of a cube into two equal parallelopipeds, &c. hence do these cool sooner.

Cor. 15. Hence the more solid are our fibres, the longer do we keep warm, as we see in strong men ; they keep longer warm than those of wat'ry constitutions and weak fibres.

Cor. 16. 'Tis a question, whether the blood is hottest in the heart ; but I say 'tis of an equal temper from the coldest blood of the veins, and warmest of the arteries mix'd. We can't bear too hot blood, nor too hot air. A bird, a dog and a cat were tryed in a sugar hot-house ; they all died soon, and so do the men, if they don't retire ; hence 48 times hotter than usual, will breed fatal diseases.

Cor. 17. The denser, the larger, and the more spherical bodies are, the longer do they keep hot ; moreover, the lighter is the air it contributes.

Cor. 18. Yet all bodies do soon cool in the air.

Cor. 19. Is not vibration of the elements then a cause of the fire's continuance ? The sound of a bell continues for many minutes, and even longer than we hear it, as appears by sand sprinkled on it.

E X P E R I M E N T XXI.

The denser bodies are, whether fluid or solid, the longer they are in heating; this is plain by boiling liquids, and by the Thermometer, from air up to Gold.

Cor. 1. Hence bodies admitting entrance later, cool later.

E X P E R I M E N T XXII.

The greater bodies are, *cæteris paribus*, the slower they are heated. This may be looked upon as an axiom.

E X P E R I M E N T XXIII.

The denser and greater bodies are, they require more fire to heat them to the utmost heat, *v. g.* lbj. of Iron, a plate of it heats sooner than a sphere of it. Hence the surface is the measure of receiving and letting go the fire.

E X P E R I M E N T XXIV.

There is no body found, that will be hotter than all the rest; for if the hottest bodies rest a while in the air of the same temperature, they are reduced to the same degree of heat and cold as the rest; phosphorus is as cold as water in water; linseed oil in a frost, tho' it don't freeze, is as cold as ice in a frost; the same may be said of alcohol, mercury, spirit of nitre, steel, flint, and all others; so that no body whatever is disposed more for heat or cold, none grows hotter of its own accord than another.

Cor. 1.

Cor. 1. Has then a dense body, in heating, more fire in it ? or does that greater quantity of fire compar'd, owe its heat to a greater fire applied to that body ? or does a constant application of the same fire cause, that a greater quantity of fire is got to that body so heated ?

Cor. 2. Whether the physical cause of the long detention of the fire in a heated body be the fire itself insinuated into the body ?

Cor. 3. Or whether the cause of this detention be the body heated and the fire too ?

SCHOLIUM.

Thus have I essayed several enquiries on the nature of elemental fire, and as it resides in bodies ; as also its *motion or attrition*, before I treat of its nourishment ; this difference Chymists hitherto have not considered. Now we come to common fire ; an Iron-rod when heated is $\frac{1}{60}$ longer ; a glass Cylinder a span long heated is $\frac{1}{50}$ longer ; a ring of metal is $\frac{9}{100}$ wider ; a glass Globe is extended $\frac{1}{1000}$ more by the heat of the hand ; a Thermometer in hot liquor descends first, then ascends ; in cold, ascends first, then descends ; heat expands liquors *per saltus* ; mercury in a glass heated by water till it boil'd ascended gradually, therefore such a Thermometer is best ; two rods of metal equally heavy, the one heated, the other cold, the hot one is lightest (y) ; if a live-coal be put under the cold one, they equiponderate ; if a coal be put under, 'tis heavier, if above 'tis lighter, where there was an equilibrium before.

(y) He says otherwise before.

Of the PABULUM of FIRE.

Since it seems indisputable, that fire always exists in the same quantity unchangeable, and that it inheres in some bodies, as gold, silver, &c. without destroying them, we now come to try in what bodies it may be bred and detained long enough ; and even so encreas'd as to consume them ; till no more of these sustaining parts subsist, but have vanished.

Wherefore as soon as these parts, and the body is consumed, we say the *Pabulum* is wasted, and justly, but it wants proof to affirm, that this *Pabulum* is changed into elemental fire newly created ; and that it is encreased thereby ; for what would have ere this become of the world, if it had been so augmented ? but we have no sign of this, for it is now, as it has ever been, without increase. *Cruquius* proves this in his Tables of meteors, where he proves there ever was an equilibrium of heat. Whole woods on fire have not encreased it. Don't you wonder, that neither plants or animals have suffered, as they would, in near 6000 years, if the fire had encreased ? But nothing has yet happen'd ; they would have perished with either too much or too little heat. The eggs of animals are burnt with a heat equal to 100, nay, in 70 they scarce are ever hatch'd. Insects eggs keep all winter, but die with any sharp heat. Hence the same heat is now as ever was from the creation ; neither volcano's, nor meteors, nor stoves, nor furnaces, nor bombs, have encreased it, and I hope to prove that these *pabula* have not changed it. All things have combustible matter, wherefore we will examine them all.

All vegetables will consume with fire, whether wet or dry ; all crude vegetables have *water spirits*

rits that are odoriferous, and invisible, an *acid* that appears in a liquid form, an *alkalini volatile salt*, a *volatile oil*, a *fix'd oil*, a *black coal*, *white ashes*, a *fix'd salt* in these ashes, and *earth*: Now let us see what it is in these that is inflammable.

The plant first fumes and exhales in a *pellucid smoak*, the water with an acid or alkali in it; next a *black smoak*, and stinking exhales; then succeeds a *flame* which is clear of smoak, unless it goes out; if this smoak be received on any body, it makes soot; last of all the ashes are left, which in volatile plants is mere insipid earth, as in garlick, &c. (*sc.* fetids and acrids) but in other plants 'tis a fixed salt.

In dried plants all is the same, only the water is not so plentiful; in rotten plants, and dry, they scarce flame, they only shine and give out a little salt.

Hence then water has a great share in the flames; for altho' it can never be heated above 212° , and so can never be made to shine, yet if thrown on coals, it makes them burn, unless there be too much, so as to extinguish the fire; if thrown into boiling oil, finding 600° of heat, whether hot or cold, it forces the oil to bubble and boil over, and fly about; for meeting with three times more heat, and making its way to the bottom by its greater weight, it must be toss'd wonderfully; so if to a mortar a little moist, you pour in hot fix'd salt, it is thrown and toss'd about wonderfully, and with hazard to the by-stander; but this appears most in melted Copper, into which if one drop of rain or moisture falls, it flies out, throws down the furnaces, and kills all around.

Next, let us consider the spirits in vegetables; we find nothing in them fit to nourish fire; for if you throw them on the fire, they put it out.

For rosemary distill'd affords nothing inflammable, order it how you please, but it extinguishes it.

Then as for acids got from Box, Guaiacum, &c. made pure by rectification, and appearing in a liquid form, separated from all oil, they extinguish the flames; and the same happens from acid spirits got from balsams; nay, the acid got from Turpentine does the same. Sulphur indeed flames, but the acid flies off, and 'tis the oil only that feeds the fire.

As for volatile salts cleared of their water, spirits and acid, they fly off and don't flame, neither do the volatile salts produced from putrefaction nourish the fire: I understand the volatile salts cleared of their oils; for such will flame.

But oil when 'tis elemental, essential and pure oil, will flame, tho' less when rectified and rendered thinner by frequent distillations; that is, it flames more, but smoaks less; its fœces after distillations don't flame. When thus rectified it flames all away, and leaves no dregs. Drop a live coal into cold or hot etherial oil of Turpentine, it is extinguished as if you dropt it into water. Pour this oil on the flame of a candle, and it puts it out; and the same happens to all essential oils whatever.

All cinders, if you exclude the air, or throw on water, or smother them with ashes, lose their fire, and are black; they soon take fire again, but don't smook; however their invisible steams will kill animals if a chamber be close shut; when their fuel is gone, they turn to white ashes, and will not afford fire; so paper whilst black when lighted, spangles till it becomes white ashes, and then no more. This black is oil, the spirits, &c. are gone; hence oil is only inflammable.

The

(z) The ashes are mostly mere earth with a little salt, fix'd or volatile; the fix'd salt won't flame. The ashes are so much earth, that workers in metals make cupels of them with water; they won't flame.

Again we now see what it is that nourishes elemental fire; till flame appears there is a thick smoak, when it breaks out, then this smoak vanishes (*a*); smoak then is a quick motion of mix'd parts, not yet set on fire fully: Flame then is smoak set on fire (*b*); a bright flame consumes all the matter without smoak, as may be seen in *Dalesine's* chimney, where all turns to flame and ashes.

The instrument invented by *Dalesine*, and much about the same time by *Fassel*, is as follows, *Pl. 4. Fig. 1.* *A, B, C, D,* is a hollow Cylinder of Iron plates, in whose base *B D,* is a grate *B D*; this Cylinder is exactly fitted to a cylindrical tube *E, F, G,* and the tube *E, F, G,* is of the same size with *A, B, C, D,* and of Iron, and is open at *G,* shut at *E,* if then the tube *E, F, G,* be first well heated, and charcoal put on *B D,* and on them some combustible matter, then the flame rais'd descends into *E F,* and goes by *F G,* and out at *G* (the chimney); now all the smoak going this way, is forced thro' the flame that fills the tube, whereby it loses its thickness and falls into flame, and makes no smoak, nor leaves any foot; I also caus'd the same machine to be made in another shape, *Pl. 4. Fig. 2.* *A, B, C, D, E, F,* is a hollow vessel of Iron plates,

(z) He relates here the method of making fix'd salts, which is done again at large in Vol. II. p. 51. Process 9, to Process 15. p. 68. wherefore I omitted it, not being much in humour with tautologies.

(*a*) This he has told us often before.

(*b*) So says Sir *Isaac Newton*.

sodered together ; 'tis only open at top *A, B, C, D*, at the height of *E I*, there is a grate *I, K, L, M*, then on the side *D F*, let there be an (c) elliptical hole *N O*, of the breadth of *M K*, and of the height of *E I*, to which is applied the tube *O, G, H*, open at *O N* and *H*, and of the same width ; put live coals on *L K*, the grate, to heat the vessel, at the same time the air in the opening of the tube *N, O, G, P*, is heated ; I put live coals on the part of the tube *N P* for the same end ; assoon as the air within the grate, and in the tube *N, O, G, P*, is heated, the heat that was first in the vessel *C K*, above the grate with the coals, begins to lessen ; then in proportion the heat in *F* under the grate, and in the tube *N, O, G, P*, increases ; so that the force of the fire with its flames is driven downwards, and then a coldness begins above the grate : Put in any combustible matter of whatever sort then on the grate, the smoak goes down thro' *O, G, H*, and comes out at *K* without smoak, and there will be a great heat and crackling whilst *C K* is cold ; moreover bodies that us'd to smell whilst burning, don't smell at all, but are all consum'd to ashes under the grate ; all the rest are driven into the space *L, F, O, G, H* : So that all the combustible parts are turn'd into flame, and smoak is combustible matter highly agitated, but flame is this matter shining by reason of the matter's being thoroughly heated. Again, Guaiacum distill'd, if you put a candle to the smoak coming thro' any chink, it flames ; smoak is then near a-kin to flame : Nothing gives nourishment to smoak but oil.

(c) It chances to be a square hole.

Soot

Soot is a woolly substance, it arises from smoke which gradually blackens the matter, and by degrees accumulates; 'tis very inflammable; it affords by distillation water and spirit, which extinguish fire, then oils that flame much, salt, and a black cinder.

Oil then is the only *Pabulum* of fire, and this of any kind (d).

Nothing crude from vegetables will nourish fire; wine produced from fermentation, and made pure, cast on the fire extinguishes it; and distill it into spirit, still its steam scarce flames; but re-distill it, it will flame away, which no part remaining in the dregs after fermentation will. Moist Vegetables heaped up do at last putrify and turn into flame, which dry ones don't, unless they be moistened. As soon as they grow hot and then cool again, the substance is rotten, but this rotten stuff distill'd gives out water that choaks the fire; and for the rest, it affords all that other vegetables do that are burnt or fermented.

Vegetables perfectly putrified being distilled, afford a fattish stinking water, which is a water and a volatile oily salt, both these extinguish the fire; next this water comes oil, volatile salts and thicker oil, the oil only is inflammable; especially the pitchy one. Lastly comes the *Phosphorus*, there remains the cinder, which is earth without fix'd salt.

As for water, spirits, salts and earth, they grow hot, and communicate their fire to other bodies, but nothing, even in gums, flames; but inflammable spirits and pure oils do always flame, so long as they last, and are the only matter that

(d) There is but one oil; all its differences arise from other mixtures, that are not oil.

nourish fire ; when these are taken off the rest won't flame ; the other parts are highly agitated, and help to drive the flame to the inflammable parts, and hinder their too sudden consumption.

Hence it is, that by this great agitation of the parts, the oily burns fiercer and stronger for the others being intermix'd ; for pure alcohol and other oily bodies, tho' they burn faster, don't burn so fierce.

All alcohols will mix with each other, and all essential oils will mix with each other ; camphire will mix with alcohol ; all these have a cohesive property , alcohol when in water looks like little eels, so do oils with alcohol ; the more perfect is the alcohol or oil, the less fiercely they burn, and the purer, the weaker is the flame. Let us now see how the fire and its *Pabulum* works.

E X P E R I M E N T I.

Immerse a brimstone match lighted, or a red hot cinder into spirit of wine, they are extinguished quickly ; let them touch the surface, it flames.

Cor. 1. Plunging then extinguishes, but touching the surfaces lights up a flame ; strange (e) !

Cor. 2. Fire then does not always make inflammable bodies flame.

E X P E R I M E N T II.

If alcohol be warm, and you approach within the steam with a lighted match, it presently takes fire, but only the surface is in flames ; if you boil

(e) Our author says this is a *Phanomenon* observ'd as yet by none ; 'tis very commonly seen every day.

it, and shut it up in a close chamber, and then approach with a candle, there is a flame seen all over the chamber, that lasts a moment ; the spirit burns only on the surface, not under it ; so that heating the spirit of wine, and making a large surface, are two methods of consuming a larger quantity of it ; but putting a red hot cinder into it, it is soon extinguished, as if it were put into water ; for the spirit of wine's heat is less than that of the hot cinder's, and therefore is it extinguished, it being reduced to 180° ; and nothing of combustible matter will flame with that degree ; besides plunging the coal, it is removed soon from the commerce with the air.

EXPERIMENT III.

I have often thought with my self, whether I could learn by experiments the action of fire upon its *Pabulum* ; I took spirit of wine and made it flame, and plac'd it under a glass bell, whose figure you see, *Pl. 4. Fig. 3, 4.* ; so long as the glass is cold, the spirit's flame makes it appear clouded, but as soon as it is heated it grows clear ; there can no smok be seen, the flame is equal from the bottom to the top, but *striae* run down the glass ; but these *striae* are not spirit of wine, they are plainly wat'ry ; the vapour at top does not flame at a candle, but it extinguishes a match ; whether we can't separate all the water from alcohol any other way, or the alcohol turns into water, or the air supplies this water, I don't know. The alcohol is pure, made with salt of tartar, but water joins in easily with spirits ; this young *Jeoffroy* found as well as my self. In order to a further search into the nature of fire, I put matter into a cylindrical vessel that was all combustible, it flamed all away without smok or dregs

dregs, turn'd into vapour, and that into water, I could go no further : I wish I could have had leisure to have discovered the quantity of water ; *Jeoffroy* says, half alcohol was water. This seems to happen to alcohol, as it does to spirit of sulphur ; in clear weather they get little spirit but strong, but in rainy weather they get more and weaker ; the air then supplies this water, and the spirit flies up and away. It may be that alcohol is a pure *spiritus rector*, that resides in a great deal of water ; for my own part, I was astonished to find, I could see nothing but water and a volatile vapour. All science is limited ; the *Pabulum* of fire turns into water, and becomes itself aerial.

E X P E R I M E N T IV.

Pour alcohol into any vessel, place it upon a charcoal fire, and put the glass bell over it, make it boil but not flame, yet it throws off no steam, meanwhile you see *striae* running down to the bottom of the bell ; when it has boiled well, apply a sulphur match to the upper orifice of the bell, it does not flame ; nay, this invisible steam extinguishes it ; but if you apply it under it, the spirit flames in an instant, and throws all about it furiously ; so that you must stand at a distance for fear of harm.

We find that the alcohol will flame with flame only, for boiling won't fire it.

The match takes hold of the steams floating in the bell in an instant, and all flames up till it reaches the vessel in which is the alcohol, and then these flames cease, and the spirit only flames till all is wasted. Hence spirit of wine whilst it boils and steams without flaming, disperses itself all around, and is unchang'd, because it flames so quickly ; but out of the glass it loses that force ; Why ?

Does

Does so much of the *Pabulum* of fire perish, as it exhales flame? Does it perish and can't revive? Is then the *pabulum* of fire reviv'd daily? that is, is oil and spirit re-created? by fermentation, putrification, vegetation and distilling? Or don't combustible matter consist of much water and elemental fire, which being let loose flies off?

EXPERIMENT V.

Oil of turpentine cold extinguishes a lighted sulphur match plunged into it, like alcohol; and so it does a live coal thrown in; hence oils do as alcohol does.

EXPERIMENT VI.

Put a lighted sulphur match to boiling oil of turpentine, it flames, but slower than alcohol; the finer it is, the less *fæces* it leaves behind, but never becomes alcohol, because it does not mix with water.

EXPERIMENT VII.

Place oil of turpentine in a vessel, boil it, place it under the glass bell, it burns as in the 6th *Experiment*, but it has a thick smoak which runs down the bell like water; 'tis very likely if these oils could be made as fine as alcohol, they would not smoak so as to blacken paper.

EXPERIMENT VIII.

Mix water and alcohol in equal parts, fire them, the spirit exhales more faintly than when alone, and leaves the water at bottom, and the flame goes out.

EX-

E X P E R I M E N T IX.

Dissolve camphire in alcohol, and set fire to them, the spirit burns away first, and then the camphire, and this appears in all cases alike; *sc.* That the finer oils burn first, the thicker last, and more fiercely as they are thicker.

E X P E R I M E N T X.

Set fire in the same manner to alcohol and oil of turpentine, the oil leaves a blackness on paper; the alcohol burns quietly but the oil crackles when it is fired, and blackens.

E X P E R I M E N T XI.

Set fire to the *Offa Lulliana* or *Helmontiana*, the alcohol flies off, and leaves volatile spirit behind; now camphire being suppos'd such a mixture, flames all away; hence 'tis a fine resin.

E X P E R I M E N T XII.

Mix alcohol and chalk, the alcohol flames away, and leaves the chalk unchang'd.

E X P E R I M E N T XIII.

Mix alcohol, camphire, oil of turpentine, and *Helmont's* offa, with chalk, add saw-dust, and make them all into a mass; set fire to them; the alcohol flames off first, then the oil, next the camphire, the rest remain at bottom untouch'd. The first steam is invisible, the next black and sooty. We see the order nature observes in flaming; 'tis easy to say that alcohol, oils, sulphurs, and, as
some

some say, nitres are combustibles, but to tell us what it is in them that is inflammable, we must say is hard.

S C H O L I U M I.

There is found then a body which is miscible with oils and water, clear, light, moveable and immutable, which when set fire to, flames all away, and this is the only and true *Pabulum* of fire yet known; whilst it lasted unconsumed, fire lasted; and when it ceas'd to flame, there was no further appearance of fire, therefore it may be deem'd a true *Pabulum*: all the time it flames you observe no smoak, which all others had; we indeed observe water to issue from it; it is all combustible and volatile, nor does it leave any spark, as naphtha, petroleum, camphire, and all others do; it does not smell as other combustibles do; hence 'tis homogeneous; it flames alone; hence the *Pabulum* of fire needs no consistent body; it unites with water, but repels it when in flames; it is produced uniformly from all vegetables by fermentation, without which 'tis not bred; the fire only shews it to contain water, but *Helmont's* boasts are vain, who says, by salt of tartar he can convert alcohol into half water; solid vegetables are changed as this alcohol is, *sc.* they consume as it does, and being collected do flame again, and leave ashes behind.

S C H O L I U M II.

Alcohol resembles fire, it coagulates blood, serum, choler, and whites of eggs; flesh, nerves, the bowels, and bread it hardens, as if the bread were toasted; Is it a magnet of fire? Does it effervesce with fire? All other oils tho' ever so
fine

fine and subtle, leave fœces behind them, when consumed with flames; alcohol leaving no fœces, all washing away, and having no mixture but water, if that could be separated, what would it do? Would it act like thunder, or burn successively? As 'tis either earth, oil, or water that adheres to alcohol, could we separate these from it, and make it pure, it would be all fire; the more mixture of water, earth and salts, the more smoak there will be; mix a hundred parts of water to one of alcohol, or set fire to green tho' oily wood, or set marle or any fat earth to burn, we find no flame, 'tis extinguished; yet if the inflammable be in due proportion, the stronger will the fire be for these mixtures; the more ponderous are the combustibles, the stronger will be the fire; wood before leaves, the cedar before the willow, the iron-wood before the poplar; all bodies require heating before they will flame, and so much heat is required as to make the oily parts boil first; but as this is harder to effect in more solid than lighter bodies, hence lighter bodies are made use of first to set fire to any stuff; this fire is successive, not instantaneous, so that the lightest fires first, the most terrestrial last; and therefore as that contains little oil, the fire is not then violent; the fire is most violent, when 'tis in the middle way, between setting fire to it and its total consumption; hence very combustible matter does not afford a strong fire: the force then of the fire depends equally, if not more, on the incombustibles, than the combustibles, from the rotation of the parts that are not combustible from reverbation, as Tin before fire roasts meat sooner. This rotation may be compared to a ball in a gun, which the powder don't conquer and set fire to, but it tosses it away violently. There seem to be two causes of fire, the elemental fire, and its

pabulum

pabulum alcohol ; hence mixtures make it more violent. The cause that unites the fire with its *pabulum*, is the pressure of the atmosphere, without this all fire would be choak'd ; which is proved thus, The air exerts a pressure on all Bodies, which, as may be seen by the Barometer, encreases and lessens ; whilst it encreases, the fire burns the stronger ; for 'tis as a pair of bellows, which being double, and blowing the fire on all sides, makes metals melt soon : so the air by its repelling force keeps the combustibles at work ; I dare not affirm that combustibles turn into *elemental fire* by burning.

*Of the PABULUM of FIRE from
ANIMALS.*

Animals having the same principles with vegetables, the *pabulum* is the same ; nay, phosphorus is made of vegetables as well as animals, as in mustard has been experienced. Steams from men and beasts may be set on flame, whether from the anus or pores.

*Of the PABULUM of FIRE from
FOSSILS.*

We observe the same laws to obtain here as in the other two preceding, that nothing turns into fire but oils ; and the thicker they are, the stronger is the fire ; no oil I have seen, mixes with water.

Naphtha is not so inflammable as we have been told,---Petroleum grows more inflammable by distillation, but not so fine as alcohol ; the purer oils are, the less they smoak ; coals smoak, and leave soot and ashes. Sulphur gives oil and earth ; these make it burn the fiercer : so that its

T o M. I.

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effects

effects are produced by elemental fire, oil, and acid.

Cor. 1. Elemental fire rarefies all Bodies.

Cor. 2. 'Tis uniform in all Bodies, and is not common to any Body known to us.

Cor. 3. It is omnipresent ; that is, it is in all Bodies whatever, whether full or *in vacuo*.

Cor. 4. It is equally dispersed in all Bodies, unless some cause collects it or disperses it.

Cor. 5. That collecting cause is attrition.

Cor. 6. It expands itself around.

Cor. 7. But that expansion may be directed into parallelism, or otherwise.

Cor. 8. The Sun is this directing cause principally.

Cor. 9. Reflexion or refraction collects that cause.

Cor. 10. Hence is there a third manner of collecting it.

Cor. 11. Percussion is a fourth manner of collecting it, by Steel and Flint.

Cor. 12. This last fire is not from the Sun, as to its matter.

Cor. 13. It remains in Bodies for some time.

Cor. 14. The time it remains is proportionable to the densities of Bodies.

Cor. 15. Nothing can always retain it (c).

Cor. 16. What we have said hitherto agrees to elemental fire.

Cor. 17. The fifth manner of collecting fire is by fires ; this consumes things into invisibles, and is supposed to be fire.

Cor. 18. Nothing but alcohol turns all into fire, whose *pabulum* entirely consumes.

Cor. 19. Oils also are next to alcohol.

(c) What does the Sun ?

Cor. 20.

Cor. 20. Fire is not made anew, nor destroyed, it is the same it ever was; it is not heavy. *Boyle* wrote on its ponderability: *Homburg* has given us experiments on it. Quicksilver grows heavier by calcination with the flame of a lamp. *Du Clos* shewed, that antimony calcin'd by a burning-glass, grew heavier $\frac{1}{6}$, altho' it smoak'd. *3iv. Reg. Antim. martial.* finely powder'd by the duke of *Orange's* great Glass, grew *3iij.* heavier, but lost it in a true fire: All Calces afford the same Phenomena; I doubt not these experiments, but 8 lb. of Iron got no weight, as I tryed it. All Bodies don't acquire that weight; *Du-Hamel* and *Boile-Du* have found the affair otherwise. *v. Acad. des Sciences, p. 14, 15.*

Cor. 21. We see how fire may be encreased in any one part; we know how it dissipates or vitrifies, but we cannot say how far it can be augmented.

Cor. 22. The utmost effects of fire hitherto known to us, is a production of phosphorus in vegetables and animals, of glass in vegetables, and in fossiles in melting of gold. It may be nourished when collected any where, by alcohol as its pabulum, or oils, and encreased by bellows, by the true action of the Atmosphere, &c.

Cor. 23. Having considered how it may be collected and nourished, I shall pass on to shew how it may be produced by mixtures.

*Of HEAT arising from the MIXTURE of
VEGETABLES.*

Verulam, Boyle and *Hook* have considered this point, to wit, that heat has arose by mixing things together, and which grew hot or cold immediately, and presently returned to their pristine state.

I will first shew you the instruments used in this affair. *A, B, C*, is a great Thermometer filled with spirit of wine ting'd, so long as it may be free in *M, B, A*, to place any bodies in, the degrees are marked on the board *E G*, then place all *AB*, into any vessel, pour on the liquors one after another, and stir them. *Pl. 5. Fig. 1.*

EXPERIMENT I.

Try these liquors, the Thermometer stands at 44° , plunge it in water it is at 44° ; plunge it in spirit of wine, it is still at 44° ; pour the water to the spirit, and stir the glass, it is at 55° , then it has rose 11° (*d*); hence the water and spirit were equally hot before the mixture. 2. The air, spirit and water were equally hot before their Commixture. The air and water, the spirit and the air were equally hot. 4. The spirit and water grow hot presently, not from the heat they had before. 5. They grow hot from some physical cause upon mixture. 6. They only grow hot immediately upon mixture, not tho' you move them afterwards. 7. Then application of parts is the only reason of their heat. 8. This heat is elemental fire, as appears by the Thermoscope. 9. Much heat is lost while the Thermometer heats.

EXPERIMENT II.

The Thermometer being at 44° , water and alcohol at the same degree; mix, and the Glass rises to 62° ; hence, 1. All may be gathered, as in a forenamed experiment. 2. Alcohol heats more

(*d*) Motion makes the liquors warmer, and that makes them mount in the glass.

with

with water than spirit. 3. This heat depends on the quantity of alcohol. 4. Alcohol and alcohol mix'd don't produce more heat, but with water it does. 5. The purer the water is, the more is the heat.

E X P E R I M E N T III.

Alcohol alcalis'd, water and the glass are at 40° , mix, and it stands at 54° ; hence, 1. The same may be said as in Experiment 1st and 2d. 2. Alcohol alcalis'd grows hotter than spirit of wine, but less than water and alcohol. 3. The sole heat is from alcohol and water.

These things may be compared with what *Geofroy* mentions, in his *Monum. Act. Reg. Sc. Anno 1723, p. 13*. This is observable, that heat is produced only in the moment of commixture, which is greater the quicker you do it, and not afterwards, altho' you should shake them together; for the heat abates every moment. Wherefore we infer, 1st, That the physical cause of heat arises in the moment of contact; the liquors grow *opaque* whilst hot and pellucid, afterwards bubbles arise in the moment of mixture, but presently disappear, the reason of which is dubious. 2dly, This heat does not arise from the united substances, but from the union of the parts; and gun-powder does not sooner flash than this heat arises. 3dly, We can't determine the reason, but suppose it to be attraction that causes the heat, and repulsion the cold; once this attraction is ended, there is a rest, from whence the cold proceeds. 4thly, There is a determinate time therefore for raising this heat, and producing this cold. 5thly, Hence cold parts bath'd with alcohol, grow warm.

E X P E R I M E N T IV.

If Wine and Water be mix'd together, little or no heat is produced, whence being equally warm of their own nature, they remain so. *2dly*, Therefore wine being applied heats no more than water. *3dly*, Therefore the heat produced in us after drinking of wine depends upon the stimulus, not upon the heat that pre-existed in the wine.

E X P E R I M E N T V.

Vinegar and water mixed, produce no heat ; wherefore, *first*, Their heat being equal before, were equal afterwards. *2dly*, The cooling heat of vinegar depends upon some other physical cause.

E X P E R I M E N T VI.

Oil of tartar and water, before and after the mixture are equally warm ; whence the most fiery liquor does not appear warmer than water, which is a paradox. *2dly*, A fiery liquor mixed with water, does not diminish its coldness. *3dly*, A fiery alkaly diluted with water excites no heat with any other water. *4thly*, Therefore the same mixed with the blood will raise no heat as to this respect.

E X P E R I M E N T VII.

Water and oil of turpentine mixed raise no heat ; Whence, *1st*, A heating essential oil has no more heat in it than common water. *2dly*, This oil being near as hot as alcohol, does not
heat

heat like it. 3dly, Therefore can't this oil heat the water of our blood.

EXPERIMENT VIII.

Mix a perfect alcohol and oil of turpentine, they produce no heat ; wherefore alcohol mix'd with the oils of our blood, will produce no heat, tho' it may in the serum of it.

EXPERIMENT IX.

Spirit of vinegar and oil of turpentine apart, mount the glass to 44 degrees, but mix'd, gradually they raise it to 45 ; wherefore vinegar and the oil are equally warm. 2dly, By mixing them some heat arises. 3dly, We see that acids with oils produce heat, and the heat here is little, because the strongest vinegar contains but an 80th part of acid. *Homburg, Act. R. Sc. F. 1. p. 52.* 4thly, Therefore vinegar, with respect to our oils, creates some heat ; and in this manner vinegar differs from water.

EXPERIMENT X.

Vinegar and alcohol being equally hot with the air, namely of 42°, being mix'd, raise the glass to 52 ; hence alcohol and vinegar of themselves are equally hot. 2dly, After mixture heat is raised. 3dly, Alcohol raises more heat with vinegar than oil.

EXPERIMENT XI.

Oil of tartar and of turpentine mounted the glass apart to 45° each, but mix'd to 48°. Hence,

G 4

1/2,

1st, They are equally warm of themselves. 2^{dly},
A notable heat is rais'd in the mixture.

EXPERIMENT XII.

Vinegar and oil of tartar, each apart, mount the glass 46°, and being suddenly mix'd, they became no warmer; but here I mix'd three of vinegar to one of oil of tartar; hence in the uniting of these opposite salts fire is not collected.

EXPERIMENT XIII.

Alcohol and oil of tartar, *per deliq.* of equal coldness with the air, raise the glass from 64 to 68.

EXPERIMENT XIV.

Alcohol of equal warmth with the air, to wit, of 47° blended with dry salt of tartar made it ascend to 51°.

EXPERIMENT XV.

Put one part of dry Salt of tartar to three parts of water, they mount the glass from 47 to 57.

EXPERIMENT XVI.

Mix three parts of either with one of dry salt of tartar, they mount the glass from 43 to 49.

EXPERIMENT XVII.

Mix one part of dry salt of tartar with three of oil of turpentine, the glass rises from 43 to 48.

From

From all these we learn, 1st, That all simples treated chymically are equally hot with the air they reside in. 2^{dly}, They only grow hot upon the mixture, and return to their former temper. 3^{dly}, This heat therefore is not produced from their Substance, but their union. 4^{thly}, Alcohol and water are the chief that have this power of generating heat. 5^{thly}, Salt of tartar and water are the chief amongst solids and liquids mix'd, that generate this heat. 6^{thly}. Next to these, alcohol and salt of tartar have the chief power. Now let us view animals.

Of HEAT producible by the Mixture of Animal and Vegetable BODIES.

EXPERIMENT I, tried various ways.

Urine kept till it is of equal temper with the ambient air, mix'd with equal quantity of water of the same heat, does not change the glass; if mix'd with alcohol, it rises from 38 to 49; 'tis not changed with oil of turpentine: with salt of tartar it rises from 38 to 39; with the strongest vinegar it is not changed, nor with spirit of urine; with salt of urine it falls two degrees; with spirit of nitre it rises from 38 to 93; with spirit of salt it rises from 39 to 43, with oil of vitriol from 39 to 54.

EXPERIMENT II.

Putrified urine of equal temper with the air, mixed with water, made the glass descend a little; with alcohol it mounted from 38 to 45; with oil of turpentine no change; with oil of tartar from 38 to 36; with the strongest vinegar from 37 to 38; with spirit of urine from 38 to 36; with

with salt from 38 to 32 ; with spirit of nitre from 38 to 40 ; with spirit of sea-salt from 38 to 41 ; with oil of vitriol from 38 to 45.

EXPERIMENT III.

Salt of urine sublim'd with sand, from fresh urine mix'd with water, made the glass descend from 40 to 38 ; with alcohol it rose from 40 to 41 ; with salt of tartar from 40 to 45 ; with the strongest vinegar thicken'd to half, from 42 to 44 ; and with spirit of nitre from 43 to 60.

EXPERIMENT IV.

Spirit of salt-armoniac made salt of tartar, mix'd with an equal quantity of the strongest spirit of vinegar, being both of equal warmth with the air, the glass from 44 to 48, with the strongest vinegar thicken'd to half from 44 to $47\frac{1}{2}$, with spirit of salt distilled with bole, and rectified from 46 to 64 ; with spirit of nitre distilled with bole from 46 to 82.

*Of producing HEAT by the Mixture of
FOSSILS.*

EXPERIMENT I.

To three ounces of water hot to 47° , put one ounce of powder'd nitre, the glass descends to 36° ; to three ounces of water hot to 48° , put one ounce of borax powdered, it descends to $45^{\circ}\frac{1}{2}$; with three ounces of water hot to 46° , put one ounce of sea-salt, it descends to 43 ; to three ounces of water hot to 47° , put one of salt-armoniac, it descends to 28 ; to three ounces of water hot to 45° , put one of oil of vitriol not recti-

rectified, it rises to 60° ; to two ounces of pure alcohol hot to 47° , put one of oil of vitriol not rectified, it ascends to 60° ; to three ounces of spirit of vinegar hot to 46° , put one ounce of oil of vitriol not rectified, it rises to 60° . Ceruss, whilst it effervesces in weak *Aq. fort.* makes it rise from 44 to 57; filings of tin, whilst it effervesces in *Aq. Reg.* it rises from 44° to 56; filings of iron, whilst it boils with *Aq. Reg.* makes it rise from 44 to 160° .

I have tryed several other experiments, but fear I shall be too tedious; one thing I have to say, If you take observations on the three kingdoms, and mark them down, this history will at last be complete with respect to heat raised on mixtures of Bodies on each other; for my own part, I have not been so accurate as I should have been, lest I should abuse your patience. I have used the largest Thermometers in these trials; and considering the small quantity of liquors so large a body is immers'd in, it may somewhat change the events; but if you have a mind to try them alone, I advise to *Farenheit's* Glasses made with Quicksilver, they being the most accurate of any.

*Of FIRE produced in a cold BODY, barely
from the Access of the AIR.*

As Chymistry is always inventing new things, so nothing after Gun-powder, is more wonderful than *phosphorus*, which upon the contact of the air, rises into fire.

Animal humours, upon putrefaction, and calling off the volatile oils and salts, leave a *coal*; which mix'd with three parts of sand, or fine powder of wood, or two parts of charcoal, and a
half

half of alum, and put into an earthen retort, and called off by a fire of the last degree, gives the phosphorus in water, which the recipient contains; and this is form'd under the water upon the fire into rolls. This phosphorus of *Crafft's*, *Kunckel's*, or *Boyle's*, is kept in water, but as soon as it touches the air, it is set on a flame at once, and can hardly be extinguished; whilst it remains in the water, if the air be warmer, it shines in the dark; and being viewed by a Microscope, in the open air, and warmer than usual, it seems to boil, and then bursts out into flames, and leaves behind it an acid like *Oil of Vitriol*. It being analys'd, resembles Sulphur in nature, but wax in substance; but it differs from either by its easy ascension. *V. Boyle Noctiluc. Aer. Slare. Act. Phil.* 1683, p. 1457. *Homberg Mem. Math. & Phys. An.* 1692 p. 74 ad 80. *Nieuwent*, p. 520. *Hoffm. Diff. Chym. Phys.* p. 336.

There is another phosphorus invented, which I had from *Homberg* 1712, published 1716, p. 60. in *Diar. Eruditor.* the first was found by one seeking the Philosophers Stone in urine, and the latter by another searching after the same in human excrements; 'tis made thus, Take human dung, or flesh, or any soft part, or any vegetable flower, fry it to a black powder in a frying-pan; of this powder take one part, and alum three or four parts; mix them, burn them, always stirring, till they smok no more; always powdering them afresh, if the alum coagulates; put this black, dry powder in a dry Glais-bottle of a small bore; cover the orifice with a loose paper, that the air may pass and repass, put this bottle into a crucible, whose bottom is covered with sand, so as it touch not the crucible; put this crucible on coals with the bottle in it, encrease the fire, so as the crucible, sand and bottle may be heated; keep
all

ail these on a violent fire for an hour ; whilst it is thus hot, wax up the bottle that no air get in, let them cool gradually, and you have a black phosphorus ; pour out some of this black powder into the air, it fires in an instant, but loses its force presently in air, but keeps for three months if no air gets at it. If any moisture gets to it in the time of preparing of it, the experiment is lost ; and the air is expell'd by the fire whilst it is making ; in the calcination, all water, air, and the volatile acid are left, and nothing remains save the strong acid and dry earth ; such Bodies grow hot at the approach of the air, which enters the *meatus*, agitates and raises fire, or perhaps some other cause may concur ; but be that as it may, who will undertake to determine the power of fire ? Who would have believed this 25 years ago ? Who knows what will be found out hereafter ? What if such a powder should fall into a barrel of Gun-powder ?

*Of FIRE produced from cold FOSSILS
by WATER.*

If the dust of Iron lately filed, and not rusty, be mix'd with pure Brimstone in equal parts, so as the powder be very subtile, keep this as long as you please dry, it remains untouch'd, but if you make a paste of it with water, after some time it heats, and at last flames ; after flaming you find a brownish blackish calx, which with water gives a *vitriolum martis* ; a great quantity would make a *volcano*. *V. Hist. Ac. Reg. Sc.* 1700, p. 52. *Monum.* p. 107. The acid fixes on the Iron, and heats the Sulphur into flames. *Hoffman* relates another experiment, *Diff. Phys. Ch.* 169, by mixing oil of vitriol ℥ij , water ℥xij , keep the bottle, holding them in a moderate

derate heat, then put in ʒij of filings of Iron gradually, a white steam arises, of a nidorous smell, which is lighted by a candle; thus we see by water how flames and fire are produced, and doubtless many more will be found out in after-ages. Moist hay also flames.

Of FIRE produced by the Mixture of cold LIQUORS.

Mix *Sp. nitri fumantis* ʒj, and any essential oil (Cloves, Sassafras, Turpentine, Carways) either in equal or to ʒj ʒss, you see how soon they flame up, and leave a Resin behind. *Borrich Aët. Hoffn.* 167. *Hoffman Obs.* 38, 42, 123, 127. *Slare. Aët. Phil.* N^o 150. p. 291.

If now all that has been said be seriously weighed, we may perhaps pronounce on the nature of elemental fire. 1. It is *corporeal*, because it is extended and mensurable; if a Globe heated be plunged into water, it heats the water, and extends itself all around, and each part is heated as the distance from the Globe, as a Thermometer informs us.

2. It is *moveable and capable of rest*; this we experience, that it can disperse itself successively, and therefore can rest; hence can it be augmented and lessened.

3. It resists, so that another Body cannot possess the same space; that is, it is impenetrable, (*Ἀντιτυπία* (e) is the Greek word for repercussion;) it may be, and is evidently repercussed from Bodies into which it enters, as appears in *Villette's Speculum*, where it is reflected so as to burn all

(e) Ἀντί contra and τυπτω verbero, That is reverbation or eating back.

it touches, and the laxer were the speculum, the less would it reflect and heat; but it is reflected, or the Glass would be consumed. *Tschirnhauser's* Glass refracted upon a compass needle, moves it round; therefore this motion arises from a percussion. It is immutable in its figure, tho' it changes all other things; I cannot say whether it be *heavy*, but it is not determined to any centre; 'tis every where, subsists of itself; and all these we have seen proved by experiments.

4. It is in its constituent parts the *least of all Bodies*, because it penetrates all Bodies whatever; it fires a Globe of Gold red hot, and were this split, you would find heat, light, and all other properties of fire in every part of it: All Bodies have pores that admit it: Air, water, spirits, salts, oils may be excluded, fire alone cannot be hindered from entering and returning: Indeed gravity and magnetism pass thro' all Bodies, but their manner is not known, altho' they act instantaneously, but fire acts successively; hence is its nature manifested; its elements are the least of any Body yet known; I know no corpuscles more subtile than those of fire. The pores of Gold cannot be seen by a Microscope, tho' ever so finely drawn, even into $105\frac{1}{10000}$ of an inch; yet fire finds its pores and enters it. Suppose a great golden Globe on fire, yet it would find its passage out of it; and a small heat enters as well as a great one; to be hot and to be cold, is only to have a greater and less heat or fire. Its subtilty is evident then, and much more so, if light and colours be fire; for if there be a hole in a dark chamber, we can see all objects thro' this small hole, that is, each ray, so innumerable as they are, is seen; and upon a paper, you may thro' a convex glass see all very plainly, which shews the infinite subtilty.

5. The

5. The Elements of it are most *solid* of any Body ; for it enters thro' all Pores whatsoever, and continues itself immutable ; it divides all Bodies by forcibly entering them, and expanding itself all around ; it is the greatest mover and changer of Bodies, without being altered itself, therefore is it the most solid of all others.

6. It is the most *polished* of all others, if its Corpuscles were rough, hook'd, or woolly, it would stick somewhere, and not enter so freely, we therefore believe them to be small spheres finely polished, and the easy Reflexion and Refraction of them seem to argue them to be of this figure.

7. It is the *simplest* of all Bodies ; that it is every where alike ; suppose its nature to be a solid small sphere, every particle of it is the same in figure, bulk and solidity. Sir *Isaac Newton* seems to stand in opposition to this simplicity, having divided one pencil of a ray of light into seven others, each distinct from the other ; but then consider how subtile and simple is that one ray ! for notwithstanding the diversity of colours manifested in one ray, still it is the simplest of any we know.

8. It is *moveable*, so as never to be at rest almost ; let the Glass be settled down to 33, or even 40, yet still there is Motion ; and the Swiftness of the rays of light can neither be exactly determined by *Romer* or *Hugens*, as *Cassini* and *Moraldus*, only the less successive is their motion, the quicker are they communicated : If water were to be reduced into glass by cold, yet still there would be motion. So many degrees of heat are required to make water fluid, and so many more to make Metals liquid ; so that 'tis greater and less Heat that makes all things liquid.

Fire is not bred nor encreased, it is only made to appear, whereas before it lay concealed in Bodies ; so that fire does not multiply nor decrease, there being the same quantity of fire now, and no more than there ever was ; when therefore any body is set on fire, the *pabulum* is set on fire by the Elemental Fire that lay hid : This *pabulum* is not fire, nothing can produce fire where there is none. This Elemental Fire is the chief and only mover of all things, it neither is bred, nourished nor reviv'd ; it pre-existed where-ever it appears.

It matters not then what sort of fire Chymists make use of, whether elemental or artificial ; fetid or sweet things set on fire afford the same fire ; so that all fire is elemental, and if we can adjust the degree of fire to be made use of, it is all one whether we digest, distill, calcine, &c. with the Sun or common Fires, each of them produces the same effects, so the degree be equal, so the fire be pure ; for if open fires in furnaces act otherwise than dioptrick and catoptrick Glasses do, this difference arises from particles mix'd along with the fire, and not from fire as fire. Thus the fire raised by alcohol is the purest, and sullies Bodies the least ; next to alcohol the purest is essential oils rectified with fix'd Salts, so is Naphtha, Petroleum, and such like native oils ; next these is Wood fire, Peat or Turff fire, much commended by Mr. Boyle ; which burnt and extinguished, is the fittest for use again ; next to these are Pit-coal fire, they consist of Naphtha or Petroleum, and Earth that vitrifies ; lastly, Fire raised from the dungs of Animals dried.

The diversity of effects are various, Bodies depend on the diversity of the *pabulum*, and I shall shew you this by experiments. Wood and Peat-Turff Fires give out a steam that hurt the eyes, and make us cough ; but if you make a black

coal of them and extinguish them, and set fire again to them in a close shut up Room, they kill Animals quickly (i). We shut up an animal in a Glass, and exhausted the air, so as it could live some time, then by a tunnel we let in the smoak, and yet it lived, till we let in the invisible smoak, when it came from the fuel quite on fire, for then the animal died quickly. *D'Acoſta* tells us, that the miners in *Peru* can't melt their Silver from the Glebe by the strongest fire and bellows, but if fire be made by the fall of water, it does presently. We see how minute circumstances alter effects.

Let us view what remains on the history of fire; fire dissolves some, but not all things; a gentle and long continued fire changes quicksilver into a fix'd powder, which if it be encreased, makes it fly off; one degree fixes then, what another makes volatile. Antimony, Lead, and Coral calcin'd by Glasses, grow in bulk and weight, somewhat then is added to them; so Quicksilver well depurated and digested long in Glass phials, is fixed, its weight is encreased, and some part is chang'd into good metal; hence fire adds somewhat to Bodies. Gold, Silver, Osteocolla, Glass, Selenites, Talc, Virgin-sand, are not changed into other Bodies, nor Elements. *V. Helmont, Boyle.*

(i) A strange wonder! That an acid steam diluted with water should not kill, whilst a pure acid should! At first a wat'ry acid steam arises, and tho' this be prejudicial, yet the animal will survive it, but when nothing but a stronger and concentrated acid flies off, then no animal can bear it; consider Sulphur or Fire, what can survive its steams? Thus have I known the Captain of a Collier Ship lie as if dead for hours, by the steams of his Coals set on fire accidentally.

Fire

Fire does not separate all things, altho' we know them compounded, and they are separable by other methods; Gold, Silver, and Copper melted together, are not to be separated by fire; by Lead $\frac{1}{2}$ you gain the Copper; the Silver is got by Spirit of Nitre, and the Gold is at bottom black; the Silver is not easily got from the Spirit without loss; you get by fire the Lapis Infernalis, which melts like metal; but put in Copper, and the Silver drops; sulphureous metallick Glebes melt together, or fly off together: How often, in vain, have Essayers tried to get Metal pure from Sulphur, yet this they do by fix'd Salts, which makes the Sulphurs fly off, and the Metal settles; Antimony in the fire either flies off, or if the fire be gentle, remains; but use Nitre, Tartar, or Iron, and give fire, the Sulphurs fly off, and the reguline part stays. Aqua regia melts the Regulus, and leaves the Sulphur; Salt-armoniac in a small fire remains, and in a great one flies off, but add any fix'd Salt, you gain the volatile, and the Sal-marine stays. Sublimate in fire mounts up mix'd with Metal and Acid, but add Iron or fix'd Salts, you gain the running Metal. *N. B.* Attraction does what fire cannot.

Neither does the fire separate Bodies into their pure elements; for water kept after distillation grows mothery, smells and grows thick; Spirits abound in Water and Salts, Oils contain Salt and Earth, and Earth contains fix'd Salts.

Fire often unites Bodies, as appears in making Glass with fix'd Salts, which you may separate again by mixing more fix'd Salt, and then pour on acid and the Sand returns. Soaps, Aqua Regia, and Electra of Metals, do evince the same thing; hence fire in many instances compounds as well as separates; that is one degree mixes and another depurates Bodies; the case appears

in red *precipitate per se*, which a gentle fire makes, but the fire encreas'd makes it fly off.

The same degree of fire altering the circumstances changes the scene: *Hook* put a coal into an Iron-box close screwed, and put it on the fire, but taken out, it was not burnt; hence the Air is a *Menstruum* that helps the dissolution of Bodies; *Helmont* observ'd this, and *Papin* too; I burnt *Guaiacum* to a black coal, which could not be changed, till I put a Spark into it, and it then turn'd into white ashes, and the aromattick Oil flew off. Camphire flies off in flame in water, but put it into an alembick, and it mounts again into Camphire; Sulphur sublimed 100 times, is still the same, but if there is a chink in the Retort, it flames, and an Acid is got from it. Amber in open Air flames away, but in a Retort you get Water, Spirit, an acid Salt (*k*), and Oils.

Lastly, The degrees of fire vary things; for the white of an Egg by a heat of 92° in the air turns liquid, thin, sanious, fetid, putrid; 'tis a volatile Salt, and melts like water, and can never recoagulate by being boil'd in water; but in 200° it grows hard, keeps for ever, and affords water; in 400°, in a Retort, we get Phlegm, volatile Salt, Oil and Coal. But it would be tedious to say more on this subject.

We now come to instruct you how to manage fire for chymical Purposes; by *Farenheit's* Thermometers we can manage them to what degree we please: The Ancients divided their fires

(*k*) No, 'tis a neutral Salt; for by a fix'd Alkali you gain a Sal. Vol. Succini; and the Acid is at Bottom join'd to the fix'd Salt.

into four degrees, but we now can manage them to what nicety we please.

The first degree of heat is from 1° to 80° . This degree is fit for Vegetation, some require a greater, some a lesser degree to be green part of or the whole year, as Ever-greens; each requiring its natural Degree: If you would impregnate Oil olive with the flavour of a Rose, put a Rose into the Oil, and digest with a heat of 56° . If you would make a tincture of Saffron with Alcohol, the same degree does.

The second degree is from 40° to 94° , which heat is equal to the heat in human bodies. The Eggs of Insects were not destroyed by a severe winter, but, sticking to the plants, revived with the heat of the Spring; they live then with little heat: Fishes that have *Gills* live in water with 34° of heat, and they will bear water hot to 60° , and beyond: But Fishes that have Lungs live with a heat from 33° to 94° ; and this heat is required to make Elixirs, volatile Salts, Tinctures, and the Coction of Mercury for the Stone.

The third degree is from 94° to 212° ; water boils in this heat, it separates the Spirit from every Vegetable and Animal, and dries the rest; it renders the Oils volatile, it serves for distillations of Oils and Waters; it coagulates scum into a thick substance, and it kills all animals: As it has this effect upon animals, how can we bear such a heat, and as such a heat is required to gain volatile Salts, how can there then be any volatile Salts in our blood (1)?

(1) This is very weak Reasoning; May we not say the same of Hartshorn? when certain arguments may be brought to convince us of its pre-existence.

The fourth degree is from 211° to 600° . In this degree all Oils, Lixivia, Quicksilver and oil of Vitriol boil and are distilled; it melts Lead and Tin, and mixes them; Soaps, Salts and Oils are rendered volatile by it; it converts solids into coal; it sublimes Sulphur and Salt-armoniac.

The fifth degree begins at 600° , and by it all things melt, fix'd Salts, Oils, Sand, Lime, either vitrify or fly off; Gold, Silver, Copper, Iron, and Glafs continue the longest untouch'd.

The sixth degree is the dioptrick and catoptrick heat; this changes all things and even Gold; it vitrifies all things, as far as we see: If then the earth were to be consumed by fire, it would turn into Glafs.

Now as the whole art of Chymistry consists in directing the fire, we shall proceed to instruct you in it.

It is harder to preserve cold for any time, than to augment heat; we must chuse a proper pabulum; Alcohol gives a moderate, equal flame, which by keeping in so many cottons in one lamp, as the Thermometer will direct you, to come at the required heat; next to Alcohol may be us'd Hay, Straw, dry Leaves, Hairs, Feathers, Saw-duft, Buck-wheat, Skin, Bran, Oils, Tallow, Wax, Camphire, Pitch, Rosin, Sulphur, dry Wood, Metals, Coals, laid on plentifully; for the more fuel, the stronger is the fire; the distance varies the heat, as the reciprocal *ratio* of its distance; but who knows whether fire contracted into a point, mayn't do more than if the whole fire acted, for it seems to acquire new forces not depending on the vicinity; for the fire often is found to decrease at a small, and heat at a greater distance.

Lastly, The agitation and compression of fire within a Furnace; for thus its violence is increased,

creased, as it is by bellows also, which workers on metals know well, when they have double bellows to blow on all sides the fire to its centre. These are the causes of the violence of fires.

Thus have I finished the natural history of fire ; if I have succeeded, you must judge : I believe, however, it will appear from hence, that a chymical fire of a determined matter, degree and application, acts always alike on the same object, as to separation or union ; but without these it is not possible to determine what changes will be made ; wherefore mind all I have said, and Chymistry may be rendered perfect. Observe the degree of fire, the succession of degrees, the pabulum, the weight of the air, its heat, motion, winds, and the object jointly, and you will succeed. I shall add somewhat more on the nature of fire, That fire wants not Air, Nitre, Pabulum, Sulphur or any other Body ; that Naphtha and Petroleum are fir'd at some distance from the flame, *Diar. Erud. p. 53. 1775.* that Bodies anointed with *Naphtha* and set fire to, burn under water, *ib. p. 104. 1683.* Naphtha is set fire to by a candle in a lanthorn, *Phil. Transf. 100. p. 188.* Gunpowder was fired in a machine under Sea water, and its noise heard above water, *Sinclair, p. 301.* *Sibbald* says of lake *Strath-errick*, that it never freezes till *February*, after that one Night freezes it ; and a certain river, *Ph. Transf. N° 56. 1139.* never freezes ; and there is a cave a league from *Befanfon*, 300 paces deep, which in summer affords more ice in one day, than carts and mules can carry away in eight, but in winter it is a running river ; vapours from it betoken rain. In hot-houses, and near furnaces, it is colder near the fire, the fiercer it burns.

Thus have I search'd into the nature of fire, that excites such motions, and produces such

wonderful changes in Bodies. I submit what I have said to your re-searches, and hope your great sagacity will assist you to promote these enquiries, and communicate your trials to the publick; there is doubtless a great deal more to be discovered, which will instruct you to admire and adore the power and wisdom of God, the great Author of all.

Of the A I R.

The next in order is the air, which is yet more compounded than fire; we shall also proceed in the enquiry of its nature, as if we knew nothing concerning it; we understand by *Air*, that fluid that is not perceptible to us, but as it resists motion, that surrounds us, in which we live, and without which we can't breathe or exist.

It is the universal instrument nature uses for all its works; for in it all kinds of Bodies are plac'd, perform their motions and actions, which spring from their own nature, or are produced by their mutual or relative condition. It mixes with all Bodies, may be drawn from all things; hardly any thing operates without it, if we except gravity, magnetism, attraction and repulsion. Chymistry does nothing without its assistance; perhaps the Alchymists Stone may be made *in vacuo*, nothing hindring its maturation more than crude air.

It excites fire, preserves it, and directs it, and fire ceases without it; I speak of fire manifested by a pabulum, and by which nature and art do their operations.

Nothing lives, grows or acts without it; for if to live be to promote the Circulation of the juices, to convert them into their own nature,
and

and to encrease their Bulk, nothing of all this can be done without it.

It may be wondered I should even affirm that Fossils want its assistance; for as they want a subterraneous fire to perfect them, and as this fire can't burn without air, the deeper are these fires, the more ponderous will the air be there, and act the more forcibly; but more of this hereafter.

As to Animals and Plants, neither the eggs of Animals are hatch'd, nor the vilest Plants do grow where the air is not, is at rest, or is hermetically seal'd up; wherefore its active properties are to be known by Chymists, Physicians and natural Philosophers, because by it only they are let into the causes of several operations.

As it escapes the notice of our senses; as Microscopes are of no use to discover it, and as it is so compounded, as to contain all sorts of particles in it, even Gold, it is hard to find out its nature: Let us therefore take a view of its properties apart, and then consider them jointly, and we shall have a true idea of it.

First, It is a *Fluid*, and in all instances whatever it plainly appears that the air never loses this property; for in cold to 44° , colder than ever was known by nature, under the strongest compression and coagulations from mixtures, in all compositions where it resides in bodies, in all liquors where it lodges, in all fermentations where 'tis called factitious, in vessels, in ice, and the rest, it still shews itself in a fluid form, and exerts itself upon occasions; so that the two elements of fire and air are always fluid; indeed I once thought I saw the air sparkle, but it only appear'd upon second thoughts to be small particles of water that float in it to be frozen, and that reflected the Sun-beams to my eyes.

1st, The subtilty of its parts contributes to this fluidity ; so small are they, that a Microscope gives no notice of them ; and tho' they are less than those of fire, yet they can't enter denser Bodies as it does ; for put leather to the bottom of the air pump, suck, nothing enters, but oil, wine, &c. do presently enter. See Mr. Boyle.

2^{dly}, It is easily divided, for we can move Bodies any whither thro' it. This I call *Lubricity*.

3^{dly}, It attracts itself, tho' it is easy to separate one parcel from another, yet by the bubbles that arise, and at last unite together upon the commixture of liquors, there seems to be a *Nisus* towards a coalition, and a retention of its size and spherical form ; this may be an effect of compression or repulsion ; be it so, yet still there is a force that makes it tenacious of its figure.

If we examine this cohesive force, we find the airy particles mix like Salts with Water, and lurk in Bodies ; we observe that a large bubble flies off, and leaves the liquor less capable of bubbling after.

Its imperceptibility is evident from some experiments, which but for them we should not have understood ; for it resists Bodies, and that resistance is as the encrease of the velocities in a duplicate *ratio* of the Bodies mov'd. See *Marriotte*. And these experiments are understood of the whole air.

The air is heavy, and *Torricellius*, *Guerick*, *Pascal*, *Boyle*, and *Marriotte* have evidently proved by experiments the weight of the Atmosphere ; it is however difficult to measure the exact proportion between the gravity of the air and that of other Bodies together, because the air's weight varies every moment ; because Rains, Meteors, Storms, &c. vary its gravity ; and therefore do all effects depending

pending on this property. A series of observations continued for these 86 years have shewed us its utmost range of rise to be $30 \frac{1}{2}$ in the tube, and its fall to be $27 \frac{1}{2}$: Mr. *Nic. Cruque's* meteorological tables do shew us at one view, to a great accuracy, all the causes that concur to encrease the weight of the Atmosphere; its weight to water is nearly as 1 to 850.

The incumbent Atmosphere presses continually on all Bodies, and the quantity of this pressure is easily computed by the height of the Quicksilver in the weather-glass; for know the base and height of the mercury, and its weight being known, you know how much a column of the Atmosphere weighs. The nearer you approach the centre, the heavier still is the air; for fluids press upon their bases according to their heights; hence the higher Bodies are from the surface, the less are they press'd upon; and the more are Bodies pressed when the air is heaviest, and least, when lightest; hence this pressure varies; it is then resisted, and more if the Bodies be elastick; hence is there a perpetual Oscillation in the air, as its weight encreases or decreases: This vibration being encreased by fire also, there is a constant motion in all things, from fire and air; hence the air does not act on water, because nothing can compress it, altho' fire acts sooner on it, than on any other whatever; hence the force of fire is more universal than that of the air.

Let us now consider the air as fluid and heavy together; its weight presses *all around equally*, and this is easily evinc'd by a cylindrical vessel *A*, conical one *B*, a Jug-fashioned one *C*, on each of which a piece of paper *D* is placed, *Pl. 6. Fig. 2. &c.* each being first filled with water, and then holding your hand on the paper, and turning their mouths downward, the water does not drop out, which
it

it would, if the air did not press against the bottom of these inverted vessels; and it enters into the surfaces of all vacuities in Bodies, as will appear hereafter; indeed it does not so readily enter as Alcohol or Oil into water; for invert a glass full of water, plunge it into Alcohol or Oil, you will plainly perceive each to penetrate and mount above the water; but air does not enter above the Quicksilver in the weather-glass; hence it is not easily dissociated; but however its effects are wonderful, for by its velocity and weight, it moves great Bodies, as appears in storms; it is also in continual motion; as will appear to any one that looks at a ray of air entering thro' a small hole into a darken'd chamber; for there you observe moats and atoms in continual motion.

The air is elastick; for compress it into what less space or compass you please, upon removal of that compressive force or weight, it returns again into its former space.

This elasticity is not observable in other fluids, viz. neither in Alcohol, Oil, Water, Spirits, nor Lies; for they are not to be compressed.

The density of the air then encreases, as the weight that presses it is encreased; so if 2112 lb weight presses a cylindrical tube of air, so that the tube is full 4224 lb, 'tis $\frac{1}{2}$; with 8448 'tis $\frac{1}{4}$; with 16896 'tis $\frac{1}{8}$; with 33792 'tis $\frac{1}{16}$; with 67584 'tis $\frac{1}{32}$; with 135168 'tis $\frac{1}{64}$; with 260336 'tis $\frac{1}{128}$ th part full only: it is not easy to say into how much less space it can be compressed, for air reduced into 1024 less space than 'tis by nature, it would be equally dense and as heavy as water.

And as 1000th part of the air is either Water, Oil, Salt, Spirit, or some other solid corpuscles, when the air is highly compressed, it comes to these which cannot be compressed, and therefore it

it hardly can be compressed so far as into 100th part less than its natural space.

'Tis easy to reduce the air by double weight into a space doubly less; and the incompressible corpuscles in this case could not be observed; and as we proceed in compressing more, this difficulty will encrease upon us; for as fluids press upon the bottoms and sides of vessels, according to their heights, the tubes must be strong to bear the reduction of the air into a $\frac{1}{100}$ th of its natural space; moreover you know this pressure enlarges the vessels themselves, especially Glass, which is necessary for such observations, since we can't see without a pellucid tube, now a very high tube is requir'd, that won't dilate, and that is pellucid, and how can such a one be found; moreover the heat must be equal in its temper.

I will now shew you how this properly was found out; Mr. *Boyle* took a Glass-tube *AB, bc*, *Pl. 7. Fig. 1.* which was crooked and had two arms open at *A*, and shut hermetically at *c*, every where equal in breadth in *bc*; 'twas strong Glass, the arm *bc* was 12 inches long, divided into lines, the other leg *AB*, many feet long, then by putting Quick-silver into *bc*, the air was condensed from 48 to 3, or from 16 to 1, and he found that the air was compressed, as the weights were encreas'd. *V. Boyle* against *Linus*, and *Marriotte*, p. 151. 154.

I don't remember to have heard, that any one has compressed the air into above $\frac{1}{6}$ of the whole space; indeed Dr. *Halley* and *Acad. del Cim.* do affirm, that it cannot be compressed further than $\frac{1}{800}$ th of its natural space, but then they have not published those experiments upon which they founded this assertion; this however is certain, that compress it as much as you please, it still expands itself in proportion as you take off the weight, and *Richard Townly*, Esq; said this held
from

from 1 to 32 ; but we are not to infer farther than we know ; we know then our air can be compressed into 16 times less space, we know it can expand itself to 32 times more space than its natural state : This condensation depends upon compressing weights ; next this expansive force still remains in proportion as you lessen the weight compressing ; again after rarefaction, upon taking off the weight it can be compress'd again ; and, as far as we know, this rarefaction and condensation answer to the decrease or augment of weight : Now the *Italians* and *English* say it can't be compressed into a narrower space than 800 times, therefore their *conceal'd Arcana* have taught them this truth. Then the spaces it possesses are reciprocally as the compressing weights ; then this holds both in natural and compressed air ; next, Mr. *Townly's* proportions are not altered from 32 to 1, and, 'tis probable, the same rule holds in all degrees of compression ; but this compressed air does not pass thro' the glass for all the weight laid on.

Another law is the air's undestroyable elasticity, neither rest nor weight destroy this property ; *Marriotte* and *Boyle* kept air compressed in a Gun, and *Roberval* kept it shut up so for 15 years, and yet it was elastick as before ; and detain'd in solids and fluids for long spaces, it still is elastick, as may be try'd, and as I found in hartshorn kept for 50 years, which shewed in distillation plain tokens of this truth ; perhaps this elasticity exerts itself, when two parcels of air touch and repel each other.

Notwithstanding its density, it still remains fluid ; for as this holds true from 1 to 520,000, we may believe the air never grows solid with the greatest cold. In this elasticity of the Atmosphere, the greatest paradox is, that a small
portion

portion of air will effect what the whole will ; for in a weather-glass shut out the air, and yet that small parcel at top makes the mercury rise or fall, as if the whole Atmosphere wrought upon it ; exhaust the air in this tube, the Mercury rises to 28 inches. See Mr. Boyle, *Exper. Mech.* §. 1. Part 2. from p. 1. to 24. If then a small portion of air acts thus, what effects may it not produce in chymical matters, where fire is often shut up, and the air is highly rarefied, vessels may be broken, &c.

This elastick force is encreas'd by heat, and acts as much as it does by its weight ; for as in the weather-glass named and shut up, the elasticity lifts up the Quicksilver, as much as if the air had become denser ; Thermometers and Barometers inform us of this : So Chymists must know that dreadful effects are produced by this fire.

Drebbel's Thermometer informs us, that the air does the soonest rarefy by the heat of any other body, and its measure of expansion is so great, as never to have been discovered hitherto ; boiling water expands it to $\frac{1}{3}$ d of its bulk, and in a fire where iron is smelted, its expansion is prodigious. See *On Fire*.

In the same density of the air, the expansions are proportionable to the heat applied, *Ac. R. Sc.* 1699, p. 113. and 1702, p. 1. 5.

The denser air is by compression or otherwise, the more elastick is it ; so that a small fire, when the air is under this state, may produce prodigies, if at the centre the air were pressed into $\frac{1}{800}$ its natural bulk, a small fire would blow up the earth, if air were condensed 800 times more than it is, it would lift the Quicksilver up 29600 inches high : If then the air's weight and its heat are both encreas'd, the elasticity will be in a compound ratio of these two ; on the
con-

contrary, the rarer is the air, the less elastick is it; an air doubly rarefied requires a fire doubly larger, to make it more elastick; hence at the top of the Atmosphere, no fire almost will encrease its elasticity.

Air is condensed by cold, as by a weight; *Farenheit's* Thermometer prov'd this; of which before.

In short, the Atmosphere warm'd to 46° , in *Farenheit's* Glass, if it be warm'd to 166° , its heat is of 212° , which boils water; then the air is rarer by $\frac{1}{3}$ of its bulk, according to *Amon-ton's*; hence air warm'd to 166° , expands it one third more; add 40° of cold to 212 , that is 152° , which is the middle distance between boiling water and the greatest known cold; here the air is condensed to $\frac{42}{83}$, or near $\frac{1}{2}$; suppose the air to be hot to 90° , which is not common, it appears then, that the greatest heat and greatest cold encreases and lessens the density to $\frac{15}{83}$, or $\frac{1}{5}$; hence observe what changes is made naturally in the air's density, whence as *Mr. Boyle* observes, the air's density may be determined to grow from 1 to 520,000, and to contribute to intestine motions in fermentation and putrefaction.

Lastly, This elasticity can't be destroyed by fire itself; let a Glass-globe be held in a furnace so as to be ready to melt, close it hermetically, let it cool gently, plunge it in water, break its neck off, the air rushes in with violence; and this may be brought to a *calculus*, by weighing this globe when full of water and of air; hence Chymists may know how to manage their materials when filled with air: from all which it may justly be inferr'd this elasticity is so proper to the air, that nothing can destroy it.

Having thus considered the air's properties, we come to view what a chaos it is, since it contains
all

all sorts of Corpuscles; First there is *Fire* in it, as I have said above, and I have found by the Thermometers, even in *Vacuo*; no bodies attract it more than others, but all do contain it alike, and it is distributed equally every where, nor are there any Magnets of *Fire*. Secondly, There is *Water* in the *Air*: Do we not breathe out *Water* every moment? Did not *Sanctorius* prove a perspiration, which is mostly *Water*? Does not every body exhale *Water*? Don't plants exhale it? Has not *Mr. Hale* in his *Statics* of *Vegetables* prov'd it? Don't *Water* exhale from kitchens, laboratories, or the *Earth*? Does not the *Mediterranean* afford, according to *Dr. Halley*, 52,800,000,000 hogheads daily, by the sun's heat only, abstracting from the winds? What must be done when winds are superadded? Does not *Kruque* compute that about 30 inches of *Water* fall yearly on the *Earth*? Hence must so much exhale: upon exhaustion of the *Air* in the pump, we see the inside of the glass grows streaky and cloudy; fix'd salts testify this assertion by their flowing in the *Air*, two ounces, one dram of Salt of Tartar in three days moisten'd and weigh'd three ounces and a half and half a dram, its encrease of weight was then one ounce three drams and one half; put the same salt in a scale, it weighs more every moment; in short, it would weigh thrice its weight, were it to be long expos'd; then 'tis called *Ol. Tartar per deliquium*; distil this and you get the *Water* and leave the salt. By this gentle solution of the salt the earth is more readily got from the salt; and it is wonderful that it is hardly possible to hinder this deliquation even in the warmest place; and so far is it impossible to hinder this fusion, that designing to make an *extempore* tincture with *Alcohol* and dry Salt of Tincture, though I shut

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it up, immediately after its being poured out of the Crucible into a Mortar, and beat it there, in a dry, warm glass, and cork'd it and cover'd it with bladder oil'd, yet the Alcohol did not take a tincture, because the salt had attracted some Water.

In a Jug that wou'd contain 3*℔* of Water, and shut up, an ounce of Salt of Tartar grows moist and heavier, hence this is to be added to the Air's weight, and if an $\frac{1}{8.50}$ th part is Water, then the whole weight of the Air shou'd be imputed to the Water in it, and perhaps but for this Water in it, the Air wou'd not be heavy at all.

Now either the Air must move constantly, and apply this Water to the dry salt, or the Water moves, or we must acknowledge an attraction in the salt and the Water towards each other; thus thinks *Sendivogius*, one ounce of salt attracts three ounces of Water, but three ounces of Water require two cubick feet and $\frac{1}{2}$ of Air to reside in; but it is most likely that all these causes concur.

But nothing is more singular, than that Water should attract the salt and make an oil of Tartar, which is as 7 to 5 to Water, and to Air as 1190 to 1, in which there is nothing elastick or aerial, but all it has attracted is Water: Hence in rainy weather, the Air loses of its elasticity.

There never is more Water in the Air than when it is a dry season, only in this case the Water is more equally distributed, whereas in cloudy and hazy weather, the Water comes lower; in the first case the weather-glass rises, in the latter it falls, as in Alembicks they are clear, whilst shut, but cloudy when open, from the unequal pressure, which there was before.

Dew,

Dew, which is an exhalation drawn out of the Earth by the heat of the sun declining, for those steams which the sun drew up were clear, but that heat being lessen'd, the steams are not carried far up, for they cool and drop upon the herbage : It is a mere chaos and a mixture of every exhalable substance, and must vary with the soils that afford it, so that some has ring'd glass like a rainbow, which cou'd not be taken off; some has broke glass in distilling, some is like butter melting in your hand, and the like, so that its chief part is Water variously mix'd.

Clouds are Water collected, for when Water is lifted up on high, as in *Carniola*, which are 10274 feet high, at *Pic Teneriff*, which is the highest in *Europe*, or as *Maiguan* observ'd at *Toulouse*, there it is dispers'd, but when it appears in clouds, 'tis collected; and if the rain be divided into small drops, it is more resisted in its descent, by reason of its larger surface : *Showers* are always larger in summer, because as they fall they unite with others and form large drops, hence showers do come from on high, because they unite with many watry parts, so as to be large at last.

Fountains are generally in mountains, as may be seen in *Bernier*, on the valley of *Cachimir*, in the *Mogul's* country; but they arise from the watry parts distilling from on high. Rivulets spring from fountains, and rivers from rivulets, which run into the Sea, whence they only return by exhalations; where there are no Mountains there are no Rivers.

All Air has Water in it, which is verified so high as we can go, that is, in the mountains; and it might be possible for us to rob the Air of its Water by Salt of Tartar in a Jug, but this

wou'd be of no use to us, since upon opening the Jug more Water wou'd rush in.

In the highest places, as mountains even under the Tropics, the Water grows cold, and unites into snow or ice, this we see how high mountains always have snow upon them; and the higher the Water, the more does it freeze.

When these particles unite, they fall into snow; and hail also is snow melted into globules and falling.

Thunder and lightning arise from the friction of those icy parts together, which when they fall low produce such stupendous noise and showers, and we see that hail generally accompanies great storms.

The Airs weight being diminished, by opposite winds, makes these storms fall.

The Causes that lift up these watry vapours are the sun by its heat greater or less, subterraneous fires, which make the Earth hotter, as we go deeper; kitchen fires, frost, air, all causes that divide Water into so minute Molecules, as that they grow lighter than Air; Lastly, Winds, as Dr. *Halley* has prov'd.

Let us now consider what the Air join'd to Water does on bodies; first it insinuates itself by the Air's action upon it into all pores and passages; the Air and Water produce volatility, as appears in exposing salts to the Air, then letting the Earth settle, and evaporating and drying the salt, and all becomes volatile, the same is said of fixt salts; whenever Water abounds in the Air, relaxations happen in bodies, and they ferment and putrify, by being thus let loose: Thus Plagues have happened; since then Water in the Air dissolves all salts, no wonder of all those appearances that depend on this solution.

Hitherto we have consider'd the Air as elastic, as containing Fire and Water, let us now consider the other bodies in it. The

The Air contains in it the scents of plants, which are dispers'd in it issuing from the plants; it also contains spirit of wine in it from the hogshheads that have been fermented; it partakes of spirits from the laboratories of chymists; it shares of Chimycal Oils; it contains all species of salts, as also contains earthy parts, foot, sand, ashes (*a*) of Volcano's, and also the seeds of plants, as may be gather'd from plants growing on towers, and the mosses and other small plants disperse their seed to very distant places: The ashes of a Volcano have been found a 100 Miles off, *Ph. Tr. N. 21. p. 377.* See *Marriotte, p. 334.* speaking of a cloud that dropt hail-stones, was carried fifty French Miles; our *Perspirabile* is also carried up and adheres to bodies and hunting dogs smell it, and it infects others; so are the excrements of animals and urine carried up: Thus whales cast up, lie and smell and infect places with their stench; so do horses, camels, and men after battles infect whole countries; so also do buried animals putrify and leave bones only behind. The eggs of some insects are also carried up and are hatch'd in the Air; I hung up a piece of flesh boil'd in Alcohol, then anointed with Oil of Turpentine, in the Air, it swarm'd with maggots, that eat up all the flesh; which cou'd only come from the Air: In *Egypt* rains fall, that strike the travellers with shivering, as also others fall that corrode their skins, and cloths, *Act Lip. 1. T. 1. p. 425.* As to fossiles these are also in the Air, and chymical spirits distilled or made by commixtures fly up: *Glauber's* method shews us how

(*a*) *Republ. Literar. T. 1. p. 590.*
Transf. Abridg. T. 2. p. 143.

Ibid. 1708. p. 152.
Ibid. T. 2. p. 141.

easily they are made to appear and evaporate, and there is a determinate stratification, so that they fly up and take up their abode according to their gravity. Sulphurs also fly up into the Air from bodies under distillation; as also from mines, and breed lightnings: Even metals themselves do mount into the Air; it is plain in Quicksilver, which flies off with a fire of 600° . and the same may be said of all the rest in the furnaces of metal-makers; hence also Silver and Gold do fly up, so Gold by sublimate and Regulus of Antimony turns into an Oil and mounts, and most metals are made volatile by Sulphur, Calcanthum and Sal Armoniac; so in the mines there are choaking steams, which may be metals reduc'd into this shape by various mixtures in the bowels of the Earth. Metals are by the Air chang'd into Vitriols and dust, and are carried up; the *English* testify, that at *Bermudas* Isles, bricks and tiles are corroded. Marchasius are ripen'd by the Air; the dew that dy'd the glass like a rainbow, neither yielded to rubbing or Oil of Tartar, and yet it burn'd like Alcohol, this resembles the metallick tincture on glass. Hence Air is a mere chaos, that contains particles of all sorts, which produce such stupendous effects; hence meteors; hence various attractions and other Phænomena arise; if you hold spirits of Sal Armoniac and Nitre at a distance, they produce no effects, but as soon as you hold them together they smoak; an Amalgam of Quicksilver and Tin, distill them with spirit of Salt, they afford a liquor, which, when shut, don't smoak, but they afford a thick fume, if expos'd to the open Air, and they continue this effect for years. We know what some bodies will do, but we know not what species of them are in the Air; we see what Oil of Sassafras, and Glauber's spirit

spirit of Nitre does; thus may we explain Meteors and the like; how do we know what effects are produc'd from the aspects of the stars, from comets, &c.? Every Air differs as to its effects, which are peculiar to the place; Chymists expose salt of Tartar in their Laboratories, where they often distill vinegar, they get a *Tartarus regeneratus*, but they try it in vain where Vinegar was not; some places are inhabitable after earthquakes, inundations, &c. winds bring Airs from different places, and change the present condition of it. — Colds, heats, influence from the sun and moon bring vicissitudes of weathers. The sun in spring unties the frosty glebe, and exhales Vapours, and brings storms, thunders, rains, and it makes plants flourish; but tho' there be the same heat and weather in autumn, the plants decay. Diversities of seasons then effect different appearances.

There is one thing peculiar to the Air, that birds, or fishes, or eggs of animals, or seeds of plants, if shut up close do die, or don't grow; Blood expos'd is fluid, but when there is no Air comes at it, 'tis black; happy he who can tell us news of this Cause! *Sendivogius* and Chymists say, there is a hidden Spirit of Life in the Air. This is not yet discovered.

Now we will speak of the *Airs Gravity*, the Water in the Air, as well as other bodies in it are all heavy, and were we to take off all heavy bodies from it, perhaps it wou'd not be heavy; for in a cubick foot of Air let the 850th part be all Vapours, then the elastick part wou'd weigh nothing; hence it might happen that it cou'd not be reduc'd into a less space than one 800th part; however, if these other mixtures of Incompressibles were absent, the elastick part of the

Air might be farther condens'd. The Air and Fire are created pure and not heavy, they are dispers'd equally and the Fire acts upon the Air. In the higher atmosphere, if the Fire be less, the Air is thinner, and a less Fire will boil things there, but it always produces a tumultuous motion, hence a perpetual motion; the Air is not so rare in the lower atmosphere, therefore it is heavy only from mixtures not of itself.

Behold *Marriotte's* experiments on the Airs elasticity.

EXP. 1.

1. The Air sticks to bodies, for plunge polish'd silver into Water, you observe bubbles on the plate, which are Air that sticks to the pores of the silver, and when Spirit of Nitre dissolves silver, the bubbles are Air that stick to the surface.

EXP. 2.

2. Fill a glass with Water, suck out the Air, you see bubbles, these are only Air, that stuck to the surface of the glass.

EXP. 3.

The elastick part of the Air has some viscosity in it; fill a spherical glass with a long cylindrical neck with Water, invert it, the Water does not fall out; again fill the same Glass with a Lye of Salt of Tartar, plunge it in Oil of Turpentine, the last oil ascends, but slower than Water or Alcohol; fill two thirds of this glass, with any liquor, let the rest be Air, shut it carefully, shake them together, so that the Air and Water mix throughly, bubbles arise compounded of Water and Air; plunge this Glass
full

full of Air into Water with its mouth upwards, the Water does not enter, but is sustain'd, altho' 850 times heavier; fill this glass full of Water, invert its neck, a bubble enters, pretty large; plunge a Tube open at both ends into Water, the upper surface is concave; all these shew that the Air has some cohesion and is not easily divided.

EXP. 4.

Take three vessels, *Pl. 8. Fig. 1.* A, B, C, in one is cold Water 44° as hot as the Air, another heated to 91° , 9° , $3d$ to 150° , place them under the Pump, exhaust the Air, the hottest C bubbled up soon, the next hottest in B soon after bubbled, but in A it bubbled last; hence it is evident that the elastick Air resides in Water, that is, in its interstices; compression keeps them there, and rarefaction draws them out; hence inflammable spirits afford Air soonest.

Fill a Cylinder, *Pl. 8. Fig. 2.* AB half full of Water; fill CD full of Water, put your finger on D, plunge it into AB that no Air enter; put these into the Air-Pump; suck, the Water in C descends by D into AB, because the surface of the Water in AB is no longer press'd upon by the weight of the Atmosphere; and is in Vacuo. The Water then is in Vacuo, for nothing presses it: the Air is exhausted from CD. I leave all in this situation till the Bubbles appear no more, nor ascend into AB. Let in Air, it presses upon AB, and forces the Water from D into C; the Air being let in the Water fills not now the whole globe C, but there is an elastick bubble at C. These bubbles were not made, till the Air was exhausted, so long as $\frac{1}{10}$ of the Air is not exhausted; now as the Air naturally is never more than $\frac{1}{10}$ exhausted, the Water then never can lose its Air;
nay,

nay, Water heated to 90° , does not bubble in the Air-Pump, therefore nor will the blood lose its Air in such a case: I say the Air at top is elastick, because it contracts by cold and expands with heat.

This Air comes from the Water; we see how fermented liquors, Alcohol, Quicksilver, &c. differ in the quantities of Air they produce in the Air-Pump; and this waste by the separation of it from them: Oil of Tartar binds little, nor spirit of Sal Armoniac, all is resorb'd into the Water again. Nay, it is evident, that the Air exhausted pre-existed in the liquors, or fluids, you exhausted it from.

EXP. 5.

If Water be void of Air, and cool'd to the temper of common Air, the elastick Air, by exposing the Water, enters into this Water so exhausted of Air again. Do as in the 2d experiment of the 4th Title and experiment; if then we compress, this bubble does not mix with the Water, but expose the Water to the Air, and it mixes, and the same Air enters the Interstices of the Water as before: but more than the Water contains naturally will not enter; as I have try'd with a bubble I admitted, as in the last experiment, which never would mix with the Water: the Air from a small bubble is suck'd equally in, and is equally dispers'd through all the Water. *Staire* in his *Phys. Exp.* p. 572, supposes these Bubbles to be Fire, and not elastick Air.

EXP. 6.

Air is separated from Water by boiling; for, take AB, *Pl. 8. Fig. 3.* fill it with Water, put in it a Tunnel CD, plunge it quite in the Water; take EF, put

put it upon CD, first having fill'd it with Water, and by your finger stopp'd the entrance of any Air, boil the Water and you see the bubbles go out up to F in EF; as for the bubbles raised with Explosion, those are Fire, and they don't generate Air, for the Air comes out quietly and settles in a bubble at F; now let all cool and these bubbles enter the Water again. I try'd Rain-Water, boil'd it, try'd it as in the 4th experiment, exhausted the Air, no Air was at the top of C at first, but some days after it appear'd there; I thought the Air stuck in the Water and would not appear by boiling, but afterwards it was separated, or that the Water was changed into Air,

EXP. 7.

Frost separates Air from Water, for as the Water freezes, it swells, and bubbles appear every where.

EXP. 8.

Fixt Salts running *per deliquium* shew no Air in them, whether you boil or exhaust, or expose it to the cold.

EXP. 9.

I took Urine just as 'twas made and 90°. hot, I exhausted till the Air was exhausted to 27 Inches before it mov'd, then it boil'd, I also try'd Lyes with Salt, Sal Gem, Nitre, Sal Armoniac crude and volatile, Quicksilver.

Cor. 1. Hence Air is attracted into the void spaces of liquors, into which it insinuates itself.

Cor. 2. It is dissolved into its component parts in these liquors.

Cor.

Cor. 3. But this Air is a very small portion of the whole.

Cor. 4. And these liquors having imbib'd a certain portion, never admit of more by any method.

Cor. 5. Water impregnated with salts, does not dissolve Air.

Cor. 6. A solitary particle of Air, separated by the Water is neither elastick nor dilatable by heat, so like a Magnet when separated from another does not act, nor likewise the Air.

Cor. 7. But when this separated particle approaches to another, then it shews its elasticity by bubbling.

Cor. 8. And it acquires its own properties gain, and in mounting meets with its like, and unites into one large bubble.

Cor. 9. Salts don't attract this Air.

Cor. 10. In every liquor known there is a determined quantity of Air.

Cor. 11. 'Tis a doubt whether the Air in the malpighian Ducts of plants be the same as common Air.

Cor. 12. The Air contain'd in animal juices is not the cause of putrefaction, which requires the common Air.

EXP. 10.

The Air in Water seems to take up a small space, but exhaust it, and we find it takes up more space than Water itself, which is thus prov'd.

Place the Cone *Pl. 8. Fig. 4.* FC perpendicular in the Copper square AB; fill AB with oil till it cover FC, then put FC in the position F; then will it be void of Air, but full of oil; then boil the oil in AB, till it crackles no longer; then the oil will be free of Water and Air; let all cool;
then

then by a glass tube convey a drop of Water down to C, which is a hollow made to hold Water; place then the vessel D upon the hollow C, to cover this drop of Water, then the Cone will be void of all Water and Air; then clap the flame at G to the hollow thimble at C gently, the Water will throw about its Air contain'd and occupy a great space, by which it often throws up the conoidal Thimble; let all cool, then the Air under C will be contracted; you see then how the Air expands itself upon exuction or heat. The Air in Water is not such a fluid, as when freed from it.

The Air in liquors does not act as the Air without; hence *Borelli* is mistaken who talks of the oscillation of the elastick within us (*b*). We see then that Air join'd to bodies takes up less space then when collected from them.

The Air acts by repulsion when united, and expands itself; Air when united to bodies can pass the minutest pores, but when united to itself it finds a difficulty to pass and enter, and Air easily enters into liquors depriv'd of it by exhaustion, but not into those that are already full. Hence may it be inferr'd, that the Air in liquors does not act as common Air, for let a vessel be full of any liquor, then the pressure encreases as the height; hence there is no pressure at top, the Air gives no tokens of pressure, no bubbles appear, &c. Separate the Air, then it acts, and shews all its properties; hence in our blood it acts not as Air, and never raises bubbles; and tho' heated to 92°. yet it exerts not itself; therefore it acts not as Air.

(*b*) The Professor forgets how bottles crack; and contradicts himself elsewhere.

Here I shall subjoin an Experiment to shew you factitious Air; I put Crabs eyes and Spirit of vinegar into the Air-Pump and extract the Air to $28\frac{1}{2}$ Inches; then I pour the vinegar to the powder, by a machine contriv'd, they boil up, the Quicksilver descends 12 digits; the recipient held 7 l. of Water, the heat was 52° , hence this factitious Air, capable of filling 114 cubick feet with Air, which was to the Density of the Atmosphere as 24 to 57; therefore Air was produc'd in equilibrio with the Atmosphere which fills a space fit to receive 48 oz. of Water equal to 81 cubick Inches, supposing a cubick Foot of Water equal to 64 l. 1 ft. The ebullition was stronger than if it had been try'd in the open Air, hence preffure adds not to this action. 2dly, So much elastick Air is bred thus, as to fill 81 cubick Inches, and which can resist the preffure of the Atmosphere. 3dly, So much Air cou'd lie conceal'd in bodies without Action; 4thly, This Air has not so much weight as a vaporous Air; 5thly, What wou'd happen to us if such bodies shou'd meet in our vessels; hence I suspect such effervescences can't happen within us, because so much Air wou'd be bred as to blow us up: Lastly, There is great danger from a vacuum in our vessels, shou'd it happen; I try'd the same with chalk, the same happen'd, the Mercury descended from $28\frac{1}{2}$ to 6; so as to fill a space capable of holding 90 oz. of Water, that is 151 cubick inches. I mixt also oil of Tartar with the spirit, a great ebullition ensu'd, whereas in open Air 'tis gentle, as you see when I prepar'd *Sal Sennerti purg.* and yet there is no Air in Salt of Tartar deliquated; and $\frac{1}{4}$ of the Alkali of Tartar saturates vinegar; what wou'd happen to us, if there was such a vacuum in our vessels, and such effervescences shou'd happen? but

in pleno there's less danger; no Air is requir'd to these effervescences, nay it hinders them; 'tis then an innate property in bodies that causes these effervescences, and the Air is separated by their action.

Take 4 3 of Oil of Tartar and 3jß of Oil of Vitriol, put them into two glasses, exhaust the Air, the oil bubbles, but not the salt, mix them they boil vehemently, and rarify so much as to take up above 12 times more space, than naturally, the Barometer sinks from 20 to $12\frac{1}{2}$, hence all the Air is not extractible till the ebullition commences, some of it then adheres to the bodies till their commixtion, attraction and attrition disengages it; the salt settles dry to the bottom, and the Water swims at top; I have often consider'd whether this Air was natural, or chang'd and resembling the natural Air (c).

Spirit of Nitre exhausted does not bubble, but smoaks upon admission of the Air, which Oil of Vitriol does not; put into the spirit, in the exhausted Air-Pump, a little filings of iron, a strong ebullition ensues and a fulmination, but which does not sink the Mercury so much as expected; the ebullition ceases upon readmitting the Air, hence Explosions may arise without a proportional production of elastick Air.

In the Philosophical Transactions (d) there were put 3ß of Spirit of Nitre and 3j of chymical Oil of Caraways into two separate Glasses in the Air-Pump, the Air was exhausted and the liquors mix'd. In an instant the glass was lifted up into the Air, and the liquors flam'd, which weigh'd 468 l.; the Air produc'd and the

(c) This last is a weak difficulty, for this Air is only struck out of the Cells that held it by attrition.

(d) N^o 213. p. 212.

expansion wrought together; tho' this experiment be dangerous, yet the force might be computed by enlarging the glass, till it fail'd of this effect.

I shall add the last method of producing Air, by *Fire* and *Agitation*; thus fermentation, putrefaction, distillation, burning produce Air; liquors fermenting burst barrels; if in distillations there wants room, the vessels crack, as in distilling crude Tartar; so long as Air is entangled in bodies, it does not act, but as soon as 'tis let loose, it proves elastick. See Mr. Hales's vegetable Staticks.

Of W A T E R.

Water is the most common of all the elements, and its use is general, yet its nature is the least known, because we can't separate other bodies from it, or it from others. Hartshorn kept for half an age will afford Spirit, Oil, Salt and Wa-

(e) By way of an appendix, Chymists are always to bring the Air and its effects into the account, because all bodies that are handled chymically are expos'd to it. First, It presses all bodies, and insinuates itself into them; 2dly, It joins in with them, and loses its elasticity and fluidity; 3dly, It mixes all bodies together; which, in a vacuum or high places, does not happen, for you cannot make the Soap of Turpentine, nor disperse Salt of Tartar *in vacuo*; 4thly, It puts bodies in action, so Corrosion is not made in vacuo, v. g. Spirit of Sal armoniac does not corrode Brass in exhausted receivers; if the Air be any heavier, Water does not boil so soon, Diamonds act not without application and motion; Papin's digester, does not dissolve Bones without fire apply'd; attrition is requir'd to produce heat: 5thly, It suffers no body to be at rest, and is always changing as is seen by the Barometer, hence neither fermentation nor putrefaction happen without it; 6thly, It contains all sorts of particles, which serve as a menstruum to all, and may be called an universal menstruum, it produces Colours and destroys them, it fixes and renders volatile, &c. Observe then the state of the Air, whenever you make experiments, Camphire in an open Air flames and has a sooty Smoak, in a vessel defended from the Air, it mounts and grows purer; Sulphur in a close vessel, is always Sulphur, but in the open Air, it turns into Flowers, and an acid Spirit. So much on Air.

ter;

ter ; stones themselves yield Water ; put clay dry'd in the sun to dust, it is made a paste with Water, which is ductile and will by Fire turn into stone ; the Air contains it, as I have said, and confirm thus, ice in summer, or your hand will smooke ; pour Water into a glass, the glass is dry, mix a little Sal Armoniac powder'd, close the glass, a dew is seen on its surface, from the Air chill'd ; our breath smoaks in winter ; hence the Air has Water in it ; if Water is not more readily separated from other bodies, than from the Air ; most bodies are held invisible in Water, and 'tis hard to get it sincere.

But we must describe Water, so as to distinguish it from other bodies ; therefore 'tis describ'd fluid, without smell or taste, clear, without colour, and freezable, this is its description, and whatever answers not this description is not Water.

It is always full of Fire, where that leaves it, it freezes, see at 32° , but if it's heat be lessen'd to 73° , still *Alcohol* freezes not with so much Fire abated nor Mercury : Water at 32° to Water as warm as our blood, differs less than at 30° of cold, that is, it is as 58 to 73.

Water abounds with Air and is defil'd with all its various particles, Rain-Water testifies this. Air in Water is hard to separate, since the weight of the Atmosphere must be taken off, e'er you can separate the Air in 33° of heat ; and heat requires 150° before it can, in an Atmosphere of a middle weight, separate the Air mix'd. Hence the greatest heat in our Air and the highest Atmosphere can't separate the Air from Water (f). Fixt Salts seem to expel it, but then they fill the

(f) Not the whole indeed, but some is exhausted naturally, or the liquor expands in proportion to the external Air.

Interstices; and we have reason to believe, that the Oil of Tartar does not in Vacuo dismiss its Air, because it attracts it strongly; and when fixt Salts are near drying by evaporation they swell and attract the Air, which they scarce part with afterwards, unless by a mixture with acids. Water seldom settles without Air and its contents; let us see now how to get Water pure and sincere, to do that we must view its properties.

As to its gravity, it is hard to determine it, some bodies Alcohol, chymical Waters, &c. are lighter, whilst fountain, river, and Well-Waters are heavier, from their contents, than natural Water, some are vitriolick, saline, bituminous, &c.

Well-Water arising from a sand-bed, is pure Water; this Water is called *living Water*, because if you dig below this sand, whence it issues, more sand comes in and fills it up; now sand is angular pieces of flint, that always leave space enough for the Water to issue out; if this Water be laden with salts, or bitumens, &c. as the earth is a chaos, then that Water will be impure, otherwise this Water is to gold as 250 to 4909, or as 1 to 19 and $\frac{159}{250}$, or 20, and to Air as 850 to 1, a cubick inch of which weighs 252, 256, 260 grains; to crystal 'tis 1 to $2\frac{1}{2}$, to marble as 1 to $2\frac{7}{10}$; observe the heat of the Air at the time you compare the weight, for that makes Water lighter; Water rarifies more than metals or other bodies, and therefore observe this caution (g). When two Waters then weigh differently, the heavier contains somewhat heterogeneous; and will be dan-

(g) Pray does not every body rarify with heat as well as the Water, and in the same proportion? For if Water is made $\frac{1}{2}$ lighter thereby, gold will be warm'd to the same degree, and then the difference still keeps the same pace, *v. Cor. 5. 82. of Exp. 10. on Fire.*

gerous or of use ; the lighter, the better, if no spirits are contained ; *Hippocrates* commends Waters the best when they boil soonest, and among those Well-Water ; and *Herodotus* says, that in *Egypt* even wood settles and that they live long there ; we have none such, therefore their wood must be heavy, such as are the *Sideroxyla* or iron-woods, our box, our oak, Guaiacum, are heavy, and we may give credit to what we can't contradict ; our Water is heavier than wine or any fermented liquors.

Water is *fluid*, rises in dewy vapours, and descends in Water, not in striæ as oils and spirits ; and any heat evaporates pure Water, but Water mix'd with salts not so readily ; Dr. *Halley's* computation of Water flying off by heat or winds in the *Phil. Trans.* N. 189. p. 366, which I have also try'd myself ; and *Kruque* also observ'd, that rain, snow, hail and dew will exhale ; so that the sun and winds do exhale Water, hence 'tis moveable and divisible into minute parts : This property depends on Fire, for at 32° it freezes, but at 33° 'tis fluid by our Thermomiter, so that 33° degrees of Fire keep it fluid, but 32° only make it freeze.

But that cold decreas'd, in the hard frost at *Dantzick*, as was said on Fire, from the 33° to the 31° naturally ; and heat never encreases naturally to 80° ; hence it is evident, that Water becomes a lasting ice within $\frac{1}{3}$ part of the greatest natural heat, and the other $\frac{2}{3}$ 'tis Water ; and there must have concurred a great cause, that required a necessity in the nature of things, that Water, to be Water in that degree of heat, should turn into ice so soon as the heat was lessen'd below this degree.

This fluidity cannot be encreas'd, encrease the Fire how you please, for 'tis either the same

Fluid, or Ice, there is no middle way; and Sir *Isaac Newton* demonstrated in his *Opticks*, p. 312, that the vibrations of the pendulum in cold and scalding water were equal (*b*). But this is only understood with regard to our senses, doubtless Water grows lighter till it comes to 212° by heat; however this alters not the motion of the *Pendulum*, since the resistance is here only made by the *Vis Inertia* or density, and not the attrition or tenacity.

Its compound particles are so small as not to fall under the notice of our senses, they even seem to be less than those of the Air, since they penetrate leather, which Air could not; however as Air enters the Interstices of water, I question whether those of the Air be not less than those of Water, so from penetrability to magnitude there is no argument can be drawn, neither can we discover its competent parts by our senses.

Mean while altho' we cannot measure the smallness of the elements of Water, yet we truly know that there is no fluid who's parts are more penetrating than it, let me except *Fire* which penetrates all bodies, and the *magnetick virtue*, if by chance you should think that this acts after the manner of a liquor upon magnets and iron. Lastly, *Light*, if this is supposed to differ from *Fire* itself, and to resemble the nature of liquors, then I will ask natural philosophers if they can shew me any liquor that passes thro the impervious pores of Water, *ceteris paribus*. I know indeed that oil sometimes will pass thro' wooden

(*b*) Sir *Isaac* speaks of resistances, and that from attrition or tenacity he computes as a *product* under the diameter and velocity of the sphere; but that from the *Vis Inertia* or density of matter, as the square of this product, for ex. $3 \times 2 = 6$, and $6 \times 6 = 36$, and that rarer medicines resist as the *Vis Inertia*, wherefore he does not absolutely say, that heat does not encrease the fluidity, but not much. vid.

casks in which there is Water contain'd; but then the oil dissolves oil and resins, and both being dissolv'd flow out, where the Water does not dissolve the resinous parts of the oil, it is retained within the vessels; we see that Water does not pass thro' paper wet with oil, thro' which oil easily passes; hence also it comes to pass, that the thicker liquor of sugar turn'd into syrup passes sometimes thro' wooden casks, which however keep back the Water; for sugar diluted with Water is a Lixivium, which by virtue of the soap dissolves the tenacious parts in the wood in which the Water is shut up; hence also Saline Lixivia, I speak chiefly of alkaline fixt salts, can hardly be kept in wood vessels, in which pure Water is kept without transuding; hence Water is known to be the most penetrating, and most fluid of all liquors (i).

Metals extended into plates, jewels, flints, hard stones, glass and sulphurs cannot be penetrated by Water, neither can hard ponderous and resinous woods be penetrated by it; indeed, soft, light, watry and saline woods do admit entrance to it; also porous stones, earthen ware, bricks and common cement of lime and sand, Porcelain vessels, and cements of chalk stones, tho' dry'd to glassy substance, do admit of Water; but glass is no way chang'd nor penetrated by it: for *Clavius* put Water into a glass, seal'd it up hermetically and mark'd it with a diamond how far the Water reach'd, and this was found as full in *Kircher's Museum* 80 years after as it was at first.

(i) This paragraph contradicts itself in every article; for if he means by *penetrabilior* more penetrating, then Fire, magnetical force, and light are more penetrating.

He generally in his whole Treatise takes this word in an active sense, therefore why does oil, sugar, &c. pass, when Water does not?

If Water cannot pass thro' any body not fusible by heat when closed up, then neither will it pass by the help of the Fire, this we are taught by chymical experiments every day, this *Clavius's* experiment shews us, this *Papin's* Digester for softning bones, this the great *Æolopile* full of Water and thrown into the Fire shews us, which only passes thro' the small orifice; and *Stahl* believes that Water by heat may be so attenuated as to pass thro' the glasses; but this he cites upon others credit, and there is a great difficulty of cementing the glasses so that it shan't pass thro' the Lute. *Becher* affirms, that by repeated distillations it will become corrosive; however I've never seen any signs of this penetrability or acrimony. I have been often convinc'd that nothing is more difficult in chymical operations, than to take care that nothing is lost, or nothing new mixes with bodies.

Pressure itself will not make Water to pass thro' the vessels, not even in *Papin's* Digester; the same was formerly tried in this hydraulick machine ABD, it consisted of a hollow cylinder AB made of brass and solder'd every where, and shut up only at B. Into the tube BC, which was then at C 6 foot high, it ascended to D, so that there was a communication betwixt AB and ABCD; and there was at A a small tube E a little higher than AF. In AB thro' which the liquor from AB could be retained or let out, when then the Water let in thro' DE being open had fill'd AB, then E being shut the Water was pour'd thro' DC which press'd the Water in AB so strongly, that this vessel was so distended, that the copper plate AF was press'd outwards, and

(k) How can Water be colder than Stones, for all partake of the same Air; and are heated and cool'd alike. and proportionably.

lifted

lifted up, altho' a great weight was put upon it yet not a drop of Water came out; but when the Water was put in at D, the folder was broke and the Water flow'd thro' the chinks; hence 'tis plain, that Water pressed with the greatest force cannot be pressed thro' passages, which it does not pass of its own accord by its own tenuity. *Plate IX. Fig. I.*

The *Academia del Cimento*, in the experiment which they try'd in a globe of metal, thro' which the Water pass'd by pressure, seem'd to contradict this assertion where it pass'd thro' the pores of the metal; but a sphere which is greatly press'd has its pores enlarged, and the Water pass'd thro' 'em, which when the pressure ceases grow less again.

We know then that the elements of Water cannot be more encreased than by Fire, nor more lessen'd than by cold, and this diminution reaches no further then 32° of heat, for then Water is no longer Water, but ice in which bubbles are formed, and the particles are enlarg'd; hence we understand a paradox, which plaisterers say they have observ'd, namely, that Water the colder it is pierces thro' the walls more fiercely, but less when heated, it appear'd above that Water is more condens'd by cold than stones, hence it may be that cold Water can pass where hot cannot.

Hence Fire does not lessen the elements of Water, but extends its bulk, and there is the end of the power of Fire upon Water. I've distill'd rain Water receiv'd upon astronomical glasses, and kept it for many years, and found it always to be the same, whether hydrostatically or chymically try'd.

But as 33° of heat keep Water fluid, we know it is always mov'd by this Fire, 'tis this Fire that

makes ice into Water, 'tis this that occasions the solution of salts, which some attribute to attraction, Water has always a tremulous motion; and our microscopes discover a motion in it.

The elements of Water are unchangeable, and this is true, whether you consider them apart or join'd into a mass, for its figure returns, as also all its other properties after any operation whatever; if it chang'd its figure, its other properties would be changed; suppose its elements were spherical and it should become cubical, then the spaces between wou'd be larger and it wou'd be lighter; in the *Æolopile* the Water is agitated, but this vapour being receiv'd in a vessel, 'tis Water again.

Whence 'tis not as *Cartesius* and *Staire* affirm, compos'd of particles like eels, they are not indeed flexible, but hard as diamonds and spherical; for if a globular particle of Air should stick in the spaces, the space of Water wou'd be to the space of Air, as 100 to 7, or 14 to 1, as *Kruque* computes.

Water is not compressible, as has been try'd by the *Acad. del Ciment*. *Du Hamel* says the same; but *Colbert* tells us, that a sphere of lead fill'd with Water could be compress'd; and *Bacon* says, that a tin globe full of Water compress'd strongly, the Water let out at a hole and boyl'd, says it spouted out three feet in length, and *Staires* affirms it; which last seems to destroy the opinion of the *Florentines*: but two things are to be consider'd, 1st. The Air may enter and hide itself in the liquor, which being compress'd it will flow out at any place so long as that Air does not expand itself to an æquilibrium with the Atmosphere: 2^{dly}, Metallick parts may suffer a breach from whence the Water may flow, but the *Florentines* took off these objections.

Q. ? 'Tis wonderful that the compression of the Atmosphere does not alter it's density ; 'tis therefore wonderful that the author of nature shou'd make one element elastick and the other not so ; there is a necessity for great caution in these trials, and no Air shou'd be shut up but what the Water contains, then we must carefully mind that the heat be the same all the time of the trial, because that expands the Water. 3dly, You must take care that the Air contain'd in Interstices of the Water be not elastick, we must therefore observe that there be no bubbles in this Water.

We next consider the simplicity of Water, which is found in every particle to be alike, unchangeable in all its properties ; hence the Alchymists supposed all things were made of Water ; hence *Paracelsus* and *Helmont* inculcate the same ; and hence they said, that all things could be return'd into Water ; but this is not reveal'd to us by experiments ; for after the ancientest of all authors, *Moses* had deliver'd to us, that the spirit of God had breathed upon the Waters, and imbued all bodies with their virtue ; the *Phanicians*, *Aegyptians*, and *Thales* broached this opinion, which the Chymists receiv'd. The *Helmontians* acknowledge two simple bodies only, pure Water and Quicksilver ; and some affirm Mercury to proceed from Water, because 'tis at last resolv'd into it ; hence they esteem Water the universal nourisher of all things, which nothing can change.

The next property is, its *mildness*, for if Water be reduc'd to the heat of a human body, and apply'd to its tendinous parts, it makes no impression ; if you apply it to the Canthus of the eye, it gives no trouble, or to the nostrils, it produces no troublesome sensation, or to the
nerves

nerves inflam'd, or to ulcerated places, it gives no torment; if you foment ulcerated cancers, or nerves that are bare and half burnt, you ease the pain, 'tis even milder than oil, it mitigates the acrimony of salts, for take a dram of Vitriol, drink upon it ℥vj of Water it hinders the effect of this poison; it is then without taste, smell, or colour; wherefore Water is adonyne.

The next property is, that it dissolves bodies and makes them fluid; *1st*, For example, it dissolves fossil salts, as Sal Gem, Sea Salt, Borax, Sal Armon. and Alcaline Salts; as also Acid Salts or Spirits, as Alum, Oil of Vitriol and Spirit of Sulphur, these three acid spirits differ little from each other, and are seldom found under a dry shape, having in them a power to attract the Air, as also Spirit of Nitre, and Sea Salt, which two are always liquid; these acid salts can be dissolv'd in any quantity of Water ever so little; for take a pound of Oil of Vitriol, the elements will be so mixed, that the whole quantity of oil will be dissolv'd in it; the same can't be said of dry salts, where Water dissolves only a certain portion of 'em; however, once you have thoroughly dissolv'd them, they may be further dissolv'd in any quantity of Water, dissolve ℥j of Sal Gem in three ounces of Water, add but one ℥j of Water, and the whole Lixivium will be dissolv'd in this quantity: This is an odd property that each particle of Water shall have its share of salt; you may observe, that concussion performs this solution sooner; *3^{dly}*, Warm Water performs this solution sooner than cold, so that cold Water to 32° dissolves slowly; but at 212° dissolves them presently, and when you have dissolv'd bodies in warm Water, part of them will subside when it cools, so that when Water comes to freeze, it expels
all

all these salts; as salt hinders Water from freezing, so the same sprinkled upon Ice, will thaw it; hence sea water seldom freezes; *4thly*, Crystallization is made for want of Water by rest and cold. *5thly*, We find this power to exert itself upon one salt sooner than another, so that Sal Gem is sooner dissolv'd than Borax, and the Water will receive more of it than of Borax. *6thly*, When Water has dissolv'd a certain quantity of any salt, till it will receive no more, yet still it will dissolve more of another salt; suppose you dissolve as much Sal Gem as it will hold, put in Salt-petre till it will not be dissolved any longer, it still will dissolve a third and a fourth.

2dly, Pure Water dissolves metallick or vitriolick salts, as Alum, Verdigreese, &c. *3dly*, It dissolves vegetable or animal salts, whether they be acid, neutral, or alkaline; but Tartar is the hardest; for example, put 4 drops of Oil of Vitriol into an ounce of Water, shake them together, and the whole will be equally acid; or take 3j of Oil of Vitriol, into which drop 4 drops of Water, shake 'em, the mixture will be equally acid; mix half an ounce of Sea Salt in an ounce of Water, part of it will subside undissolv'd; or mix brine with Water, the liquor is equally salt; the same may be said of Nitre, Sal Gem, and others; therefore that salts may be thoroughly dissolved there's a certain proportion of Water requir'd, and this holds true in solution of all salts, even in Oil of Vitriol reduc'd to a dry salt.

Put to 3 ounces of distill'd Water 9 drams of Sea Salt, if they are shaken, they are soon dissolv'd, if not, slowly; I dissolve this salt in cold Water, and another parcel in warm Water, that in the cold dissolves slowly, but that in the warm Water quickly, and in the boiling soonest of all;

all; fet them by, as soon as the boiling Water grows cold the salt settles; hence Water in summer dissolves more salt than in winter, in a warm climate sooner than a cold one, in the torrid Zone sooner than the cold one; as therefore putrefactions are proportionable to the heat, they are greater in warm than in cold countries; hence boiling Water dissolves most, and ice has the least of salt in it, all which shows that heat enlarges the pores of the Water, and cold contracts 'em; hence it appears, that this solution depends upon salt Water, and heat; wherefore, unless we know the proportion of heat, we know not the quantity to be dissolv'd; and it is certain that Water without heat does not dissolve salt; 'tis observable that ice mixed with salt will thaw; hence the salt has a power of heating and expelling of cold; I could add more, but I leave it to your speculation. Whilst the Air was of 38° , I took two ounces of the powder of Sea Salt and dissolved it in 6 ounces and 3 drams of distill'd Rain-Water; but Sal Gem required 100 and 11 ounces, and 11 drams to dissolve an ounce; Sal Armon. required a 100 and 11 ounces and two drams; 9 drams of Nitre were dissolv'd in 6 ounces; Borax requires 20 ounces of Water to one of the salt; one ounce of Alum requires 14 ounces of Water; one ounce of *Epsom* Salt is dissolv'd in ten drams of Water; one ounce of Salt of Tartar in an ounce and half of Water; 3 ounces of Water dissolves half an ounce of Arcanum duplicatum; three ounces of Water by concussion dissolves a dram and half of Copperas; hence some require more Water than others; those which run in the Air are soonest dissolved in Water, and they part with their Water latest on the Fire, as is seen in Salt of Tartar and Oil of Vitriol;

triol ; but when 111 ounces, and 11 drams of Water have dissolv'd an ounce of Sea Salt, and it will hold no more, take half a dram of Nitre, and 'twill be dissolv'd, then take any other salt, 'twill dissolve it ; vitriolick salts depofite one ounce in Water, and by cristallization and repeated folution, is all turn'd into Ochre : (1) The eafier Water diffolves falts, it retains them the fafteft; there are fome things particular about the folution of metals in Water ; fome falts diffolve metals, and they are diffolv'd in Water, which folution happens more perfectly, the more falt is requir'd ; and then this falt mixes the metal equally with the Water, otherwife a precipitation happens, which is call'd Magiftery's, Salts, Vitriols, Sugars, Cryftals, &c. The metal is the diffolvent, and the Water must be in certain proportions; if the Water is entirely taken away they lofe their transparency ; hence have we potable metals, which act by their acid and the proper virtue of the metal united (*m*).

Water does not diffolve all metallick falts, for example, it does not diffolve Butter of Antimony, which is precipitated by it into a white powder; it diffolves Alcohol, but by concuffion only, otherwife it will immerge ; alfo it will diffolve fermented oils, and brandy will mix fooner than Alcohol; but if Water be impregnated with falts, fuch for example, as Oil of Tartar, neither concuffion will make 'em mix, but the Alcohol mounts to the top, or depofites the falt, where 'tis eafily feparable from the Water ; as appears in Water impregnated with

(1) No, for 'tis all Ochre except the falt which the Water has diffolv'd, for we don't fuppofe Water diffolves Earth.

(*m*) This author in his proceffes denies this affertion ; he often denies any Acid or Alkali to pre-exift, even in bodies from whence they are acquir'd without Fire ; and yet he forgets this, wherever it ferves another turn. Is this an argument of fteadinefs of principles ?

Epsom salts, by pouring in the Alcohol, the salt precipitates, as also appears in the *Offa Helmontiana*; Water dissolves Alcohol, but not the oils that swim in it; hence rectify'd Spirits of wine, in which Oil of Cinnamon, Camphire, or Urines have been dissolv'd, grow white and precipitate; it dissolves soaps and saponaceous bodies, all soap is oil and fixt salt join'd together; it also dissolves oils highly attenuated, or essential oils; it also dissolves Air to a certain proportion, as has been said before; it also can dissolve many terrestrial bodies, particularly when they have been united to some acid salts, such as coral, pearls, &c. However, when 'tis pure there are many Earths it can't dissolve; as for its dissolving iron into rust, and brass into verdigreese, and as to what *Langelot* and *Homberg* affirm of its dissolving metals and gold, these proceed from other causes, but for earths void of all salts, such as glass, crystals, &c. it does not touch them, Water easily penetrates into bodies and their smallest pores by its slippery particles; hence does it dissolve bodies; wherefore it must encrease the weight of such bodies, and therefore merchants sell their wares to advantage in moist weather; it also increases the bulk of bodies, as may be seen in the *Acad. del Cimento. Exp. 184.* where the Cone AB, the Cone CD, after CD, was moisten'd with Air (n).

Water unites almost inseparably with salts, for decrepitate salt, and distil it, you receive a Spirit, which put upon chalk, and gently evaporate, according to *Homberg*, and you get Water, the same may be said of other salts. Sulphur itself contains Water in it, whether that Water

(n) N. B. There is no such experiment in the *Academ. del Cimento*, so that Mr. Professor has taken this upon credit.

proceeds from the Air, can't easily be determin'd; Water also is found in earthy bodies, 'tis the glue that connects them, *Paris* plaister is lime of Alabaſter, moiſten it with Water it preſently becomes a paſte and dries into a ſtone, ſo potter's clay, or bones, or ſand and lime prove cements by Water; ſtarch alſo and glues of animals grow tenacious by being mix'd with Water; the ſolid parts of animals, ſuch as horn, bones, nails and hairs, are found by diſtillation to contain Water in them, and performs the office of a glue to them; nay, chymical oils themſelves as *du Hamel* obſerves, are moſtly reſolv'd into Water, even Spirit of Wine the moſt rectify'd by Salt of Tartar, or by burning, ſhews it contains Water; however Water is not the principle out of which all things are made, ſome have ſuppoſed that cryſtal was nothing but ice which has been frozen for many ages. See *Paracelſus*, and *Acad. del Cimento*. for it has been prov'd that Water 40° colder than ever it was obſerv'd to be by nature, did immediately thaw again; it may be neceſſary for nutrition, as *Verulam* ſays, but not for the production of metals; Water alone does not afford all the neceſſary nourishment to bodies; it helps the growth of plants, and is the vehicle of other particles, particularly the ſlimy ones, according to *Dr. Woodward* on vegetation, but not the ſole nutriment.

Water refuses to be join'd with bodies, particularly with oils and oily bodies, which the leſs elemental they are, the more it repels them. Some ſolid bodies alſo reſuſe to join with Water, as the hairs of animals, and feathers of fowls, and ſome other things; however if we boil Water with fix'd ſalts, it does not then repel oils; poliſh'd bodies are found to repel Water;
hence

hence the scales of fishes hinder them from being wet.

Let us now take a view of the different species of Waters ; and 1st, of Rain-Water, this is properly the lye of the Atmosphere in which all bodies are found, as I've observ'd before, namely, Spirits, Salts, Oils, &c. the seasons of the year diversify the rain ; the vernal rain is the fittest for growth, rain after drought is the more compounded, also rains after winds brings various particles from foreign parts ; rain after hot weather is aptest to smell (o) ; whether rain Water when kept is apt to grow sour, I can't affirm ; but when it smells, it may again be made drinkable by boiling, adding a little acid, which would be of great use to sailors to know. I never could yet find by any experiments that Water would ferment, and that brandy could be had from it : I have learnt by experiments that the sea weed will grow in rain Water upon the tops of mountains, which I discover'd by the microscope when they were very young, the seeds of plants, are brought down by the Air and fall upon the Earth, even the eggs of animals are carried up, and thrown into the Water and are hatch'd there ; Rain-Water kept degenerates at last into a slimy body, and deposites a sediment, and smells and tastes badly ; however 'tis reputed the lightest being distill'd by nature, and Chymists have no finer than it is ; yet I have found that Rain-Water distill'd was of equal weight with common Water : Snow-Water is said to be the lightest, and the cleanest is the best ; hence snow found at a distance from

(o) Yes, indeed ; but it had been enough to have acquiesced, in saying that rain contain'd all sorts of corpuscles, and that heat is the aptest weather to produce putrefaction, as he had said before, therefore rain in hot weather is apt to smell. Repetition is a tedious task to hearers.

any habitable place is the most pure, it keeps the longest from smelling; *Rudbeck* shews that it leaves a crust upon the earth, which makes it fruitful; this Water digested smells, and affords oleous spirits, and a fragrant spirit which dissolves Gold; *Act. Lipsiens. Anno 90. p. 26.* if kept in hogsheds it putrefies and grows clear again; that Rain Water is the most impure that falls in hot weather, and in cities, where smoke infests the air; and I have found that after thunder it had a froth somewhat nitrous, and if Rain falls in stormy weather upon cloaths, they will abound with worms; *Phil. Transf. N^o. 127. p. 622.* from hence may be understood why Rain nourishes the ground: If we distil Rain Water with lixivial salts, or any others, they will impregnate it with their taste; 'tis purest when boil'd: If you mix this Water distill'd with common Water, the mixture grows white; this Water dissolves soap the best, it also whitens linen and wax the best, it grows warm and cools soonest; if you pour melted Gold or Silver into it, they granulate, which is useful for metal-workers to know; other metals melted on the fire, or water thrown upon them, fly off with great violence; and if Water falls upon copper whilst 'tis melting, it indangers all around.

Fountain Water is produc'd from Rain that falls into subterraneous passages, from whence it issues: These fountains are most frequent where there are mountains, for when these places are higher than where the Water flows out, then there the spring flows out so much the higher, as the place where the Water collected is higher than the mouth of the spring. (p) Fountain Water is not purer than Rain

(p) This honest Gentleman is bewilder'd in this very easy affair, for as *Marriotte, p. m. 14. Ed. Eng.* explains it, the Rains fall, pierce the Earth, and are retain'd till they make

T O M. I.

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Rain Water ; however, when it passes through flint or sand, it is strain'd from all heterogeneous parts, because the small particles are united into such pores as hinder the passage of those parts ; however, if it runs through matter that can be dissolv'd, it becomes impure, and partakes of the nature of the glebe ; hence so many Spaws, differing according to the nature of the soil ; hence petrifying Waters, which being drank do not breed the stone ; *vid. Reg. Art. Sci.* 91, 92. All Fountain Water boil'd deposits a sediment ; 'tis very singular that in wells dug 2600 feet deep, no Water should be found : See *Plott's Desc. of Staffordshire*.

The matter of Rivers and Fountains is the same, what therefore is said of Fountain Waters may be said of the other ; the chief difference is, that Fountains flow from under ground, Rivers are expos'd to the air, and consequently receive all that the winds or atmosphere can afford : They come from mountains and run into the sea, and consequently change their corpuscles as the parts they run by ; therefore we cannot easily pronounce upon their nature, to which difficulty rains, and the several creatures that swim in them, contribute : Hence does it flame under the tropics ; hence does it smell and grow sweet again ; hence, when they smell, if the hoghead is toss'd, that smell abates in five hours ; when Sea Water is distill'd and mix'd with River Water, it hinders its putrefaction, says *Du Hamel*. In the kingdom of *Congo* there is a river which affords a tenacious matter, that hardens like iron at the fire ; *Art. Lips.* 1687. p. 65c. and 1683. p. 519. The same transactions tell us, that the *Roan* water does not smell. Rain Water, Snow Water, Foun-

a passage and run forth ; and if Rains are scarce, or it don't rain for many months, these springs fail.

tain and River Water, weigh nearly the same hydrostatically; so does the Water of the River *Ganges*: 'Tis hardly credible that Water in the bulk of one pound should be four ounces lighter, and I wish Mr. *Boyle* had tried this oftner; were it so, *Herodotus* may say true of the long-liv'd *Æthiopians*. Let this suffice on this subject; only it may be observ'd, that the contents in the Water are the occasion of putrefactions.

We shall now speak of standing Waters: If we consider those ditches about *Leyden*, we find them to be a lixivium of all the filth in town, to consist of alum, tartar, and all other sorts of things, and which unloads itself into *Harlem-mere*; hence do we dye better in this town than elsewhere; the Water is more ponderous and exhal'd, affords insects, besides terrestrial matter which effervesce'd with *aqua fortis*. Rain Water is the lightest, River the next; from *Salan-Hall*, Water was two lines heavier, a Fountain Water there four lines heavier, another Water there six lines heavier, and another that had stagnated was six lines and an half, and the ditch Water was seven lines heavier; all which experiments *Hoffman* tried: From whence 'tis necessary to make use of trials to distinguish the purity of Water, which is done by Silver dissolv'd in spirit of nitre, or oil of tartar *per deliquium*, or *Sacch. Saturni*; if the Water do not grow white from these 'tis pure. (q)

The natural state of water is ice, which is fluid, only because fire is in it, this glassy part melts with the least heat; I have already taken notice that ice wou'd never make crystal, we can't heat it above 214° ; as soon as it is dissolv'd in 33° of heat, it produces all its physical operation; 'tis

(q) N.B. The professor mentions this very often afterwards.

the only vehicle of our nourishment, and which we cannot want; it is the most fluid and penetrating of any, without it our blood can't circulate; hence our life depends upon a sufficient quantity of water; it makes us grow, and all the functions of life are owing to it, death often is owing to too much, but oftner to too little; as in animals, so in vegetables it is of use, but for their growth, as *Woodward* and *Hale* have prov'd, without snows or rain there wou'd be no fructification; 'tis also of great use for the growth of metals, it dilutes them, and keeps them in the form of a Juice, it dilutes, changes, encreases and mixes 'em one with the other; hence appears the wonderful use of Water, colours cannot be seen without it, smells are brought to perfection by it, tastes depend upon it by its dissolving mixtures, aliments, medicines, poisons, solidity, depend all upon Water, so do effervescences, so does fermentation, so does putrefaction; it parts salts from earth or oils, it helps precipitation and sublimation, we can direct the degrees of heat by it, from 33 to 212. Water, indeed, is better than oil for this purpose, because oil grows thick by the fire; from hence we can keep the fire as equal as we please; the steam and exhalations of water are very active, for its steams will putrefy bodies; (r) 'tis from hence arise plagues and pestilential diseases, 'tis from hence that woody places are so unwholesome. Ice is lighter than Water, and swims upon it; the reason of which is, that the same matter takes up more space, and so weighs less, the cause of which is the Air contain'd; hence it is, that Water freezing, cracks even golden vessels, as you may see in the *Acad. del Cimento*.

(r) N. B. To wit, it dissolves the Salts and makes them act.

Ice

Ice made of water, from which the Air is exhausted, is the heaviest, and will even sink under Water; *Sagg. Exp* 171. Ice will melt with sea-salt, sal gem, fountain salt, salt armoniac; but then it encreases the cold, and this coldness may be encreas'd to any degree; spirit of *French* wine, of sea-salt, of nitre, *aqua fortis* and *aqua regia*, mix'd with powder'd ice, do greatly augment the cold, as has been said before on *Fabrenheit's* Thermometer; the strongest ice wou'd be got by exhausting the Air and pouring after *Fabrenheit's* manner, these strong spirits upon ice, but this ice is again dissolv'd by the fire, nor will it change into crystal; 'tis observ'd that Water kept in a vessel of glass hermetically seal'd for an age, will not putrefy, tho' in the air of *Rome*; *Boyle* and *Du Hamel*. Water contains somewhat subtiller than Air, for when exhausted in the Air-pump and shaken, it afforded sparkles like fire; *Du Hamel*, p. 395; tho' it abounds in the Air, yet the naked eye do not discover it, wherefore is it necessary to make use of hygrosopes, such as oil of sulphur, or oil of tartar, and such like, to detect it.

The waves move in eight seconds twelve feet and a half in diameter, whilst sound runs 680, so that a wave is to sound as 765 to one, which comes near to the proportion of the weight of Water to that of Air, they are circular, and nothing of an obstacle changes this proportion.

I very much doubt of Mr. *Boyle's* experiment, that informs us, that after distilling water 200 times, an ounce afforded six drams of earth, for the dust in the Air gets in and deceives us, and tho' I have try'd the experiment and have found a white earth, yet not in such a quantity, and I doubt Mr. *Boyle* was deceiv'd by the person he confided in.

Of E A R T H.

Philosophers and Chymists have made use of the word Earth to signify one of their elements, out of which all things were made, we mean by it a fossil, simple, hard, crumbling body, fix'd and not flowing in the fire, nor to be dissolv'd in water, alcohol, oil, or air; 'tis a body that has the triple dimension and enjoys the properties of other bodies; I look upon it to be a fossil, and mix'd with every thing we dig up, and hard to be separated from them, its weight is greater than that of vegetables, oils, &c. Pure Earth has no mixture of the other elements, nothing is more simple than it is, 'tis hard to a degree and easily crumbled or powder'd, and it will not flow in the fire, but remains unchangeable; Rain Water distill'd, gives out an Earth, which freed from all Salts, is call'd Virgin Earth; the Air abounds in this Earth, as I have hinted above in the history of the air, and by exposing black silk will be soon perceived; this powder is mostly Earth, and unites itself to all bodies, nor does the fixedness of Earth hinder us from knowing that it may be suspended in the Air; sand is a fixt body, yet it has been known to be lifted up, and destroy'd armies in *Egypt* and *Libya*; gold is a fixt body, yet the least breath will blow up leaves of gold into the Air, and tho' 'tis very fixt, if you mix it with *regulus* of antimony and merc. sublim, 'twill all fly off; wood flies into soot, and yet the Earth of that soot is a fixt body that will bear the fire; thus you learn that a body which is fixt can be lifted up in the Air.

Vegetables by burning are turn'd into ashes, which will fly up in the air with the least Earth; all plants afford this Earth; wash this Earth with
Water,

Water, you gain all the salt, and the Earth subsides; the longer you wash this Earth the purer it is, and this is the pure chymical Earth, without taste or smell, white, soft and not sonorous, indissoluble in any fluid, fixt in the fire, hard to turn into glass, which by Water may be form'd into a vessel that will bear the fire; and for Cupels, in these Gold or Silver are gotten pure by a mixture of Lead; it holds Lead and does not vitrify; this is the Earth out of which *Vulcan's* mystical fan is made, thro' whose holes all bodies run, save Gold and Silver; this is that sieve for all metals melted with Lead.

The same sort of Earth is got from the foot of vegetables, which if put into an iron frying-pan and bak'd, turns into white ashes, which being wash'd in Water leave a pure Earth, as before. Hence we see, that Earth may be made volatile, and fly up into the air; distill foot, and besides what other particles it affords, there is a black Earth at bottom, which being wash'd pure, leaves the Earth at bottom: Which shews that the Earth is fixt when 'tis freed from its volatile parts; how full therefore is the Air of this terrestrial matter, where vegetables are burnt.

When we distill vegetables, we divide 'em into two parts, one mounts, the other stays behind at bottom, the volatile part is Water, spirit, salts and oil; if they are burnt in an open fire, many thicker parts are lifted up, and therefore less Earth is left behind; whereas in distillation, the most volatile rise only; when you have done distilling, a black coal is left behind, which you can never render volatile, put it in an open fire, 'twill flame and grow white Earth; wash this, and you have the Virgin Earth; distill the Oil over again, and you have it more penetrating and pure, and equal to an Alcohol, if it be often

rectified; yet after every distillation some Earth is left in the retort. Hence we see, that Earth ascends with the volatile parts, but more particularly with the Oil, and 'tis this which makes the Oil so thick, and which being parted from the Oil, the Oil thereby becomes more pure and volatile.

Let us now consider that fixt Salt which we got from this Earth; who would have thought there was Earth in this fixt Salt since it dissolv'd in Water? take this lixivium and filter it, no terrestrial matter appears, even by microscopes, in it; and if kept for years, nothing will subside; inspissate this lixivium, reduce it by fire into a Salt, commit it to a strong fire till it flows, pour it into a warm mortar, beat it to powder, expose it to the air till it runs, and you will find the same Earth as you found in the ashes. (f) Let this Salt run again *per deliquium*, and still the same will appear, and this will happen at every solution and calcination: Weigh all these Earths, and you will find they weigh less than the Salt did, which shews that some part of the Salt is made volatile; hence may it be concluded this Earth was in the Salt, and was dissolv'd in the water, unless you suppose a transmutation of the Salt in the Earth; chymistry has always known that Earths united to Salts will dissolve in Water. Earth joins with an alkaline Salt into Glass, which may again be resolv'd into its principles; Earths by Salts may be so order'd as to dissolve in Water, as chalk with acids, &c. Hence, 1st, These alkaline Salts are Earth in a large pro-

(f) N. B. Our author has already forgot what he said on the powders that float in the Air; is not this Earth part of that powder? Or as he reproves Mr. Boyle on Waters turning into Earth, that it proceeded from the Air.

portion;

portion; 2^{dly}, The Earth is hid in these Salts, so as to be dissolv'd in Water; 3^{dly}, Nothing can attenuate this Earth so much as the fire, which causes it to unite to these Salts; wood burnt to a coal, shut up in an iron box, and committed to a great fire for many hours, remains a coal without any signs of an alkaline Salt, but in an open fire it affords Salt; for wash this coal you get no Salt, but wash the white ashes and you presently gain it; 4^{thly}, Therefore alkaline Salts are compound bodies; 5^{thly}, The open burning consumes the oil, which hinder'd the Salt from dissolving in the Water. This Salt kept long in the fire becomes volatile at last, which, however, mix'd with a certain portion of Earth, turns into Glass. 6^{thly}, No Salt is fixt of itself, but as it has Earth join'd to it, which by drying and often correcting becomes volatile. 7^{thly}, These fixt Salts are divided into a volatile Salt and a fixt Earth; 8^{thly}, Hence these Salts are Salt and Earth, with a little Water join'd to it; 9^{thly}, This Earth resides, and is got out from Water, Spirits, Salts and Oils; and if these bodies are rid of their Earth, they fly into the Air, and become invisible, the Earth remaining behind; wherefore fixity is to be attributed to this Earth.

Let us now enquire into the Earth of Animals: All Animals do putrefy, and all their parts fly off, leaving nothing but Earth behind, as appears in their Carcases.

The humours of human body being committed to the fire, by a heat of 212° afford Water, which does not differ from the Water of Vegetables, only smells of the Animal; by encreasing the fire you gain the Spirit which smells and effervesces with acids, which collected apart and re-distill'd, affords Earth; encrease the fire and you will get Oil, and these re-distill'd afford Earth, and the
thicker

thicker they are the more Earth they afford ; in this Oil is contain'd a good deal of volatile Salt, which becomes pure by rectification, but always after sublimation there is a vapid Water at the bottom, nor can we easily separate this Water from the volatile Salt ; after the first Oils, a thick tenacious Oil follows, resembling Pitch, which being re-distill'd affords a great deal of Earth, and the Oil becomes pellucid, as I have tried in Oil of Hartshorn ; so that Earth is the occasion of the viscosity of Oils, and hinders 'em from being volatile ; at last comes forth the phosphorus, which expos'd to the Air falls into flames : 'Tis a question what this phosphorus is, whether it be an animal or vegetable substance, or whether it be not the true offspring of fire ; it burns quite away, and remains like wax at the bottom of Water ; 'tis rather an oleous than saline substance, and has little Earth in it ; the Earth of animals and vegetables has a near affinity to each other, and there is also a near resemblance of the parts of the liquors ; the salts in animals are mostly volatile, neither do I find fixt nor acid salts in animals, (t) whereas in vegetables there are a great many acid salts, tho' there are also volatile salts in them.

Putrefaction separates the Earth from bodies ; for when bodies of any kind are putrefied, you gain a volatile but not a fixt salt from them ; 'tis observable that putrefy'd bodies promote fertility : One would suppose, that because putrefaction separates the Earth from bodies and other elements, that fermentation wou'd do the same ; but it never separates the Earth from Salt and Oil, it promotes acidity and leaves the fixt Salts, it changes the Oil into an Alcohol, but not the whole Oil ; we find then that Earth is always the same

(t) *N. B.* But our Author finds an armoniacal or mix'd Salt, which contains an alkaline, a fixt Salt, and an Acid.

in all bodies, and Cupels can be made as well from the ashes of vegetables as animals, it gives strength and firmness to bodies, and hinders the others from flying off, and it resists the Air, Water and Heat; in burning bodies till their whole consumption nothing remains but the Earth.

Let us now take a view of the Earth of fossils. First, We find the native Salts, such as Nitre, &c. dissolve these in pure Water, digest 'em, and an Earth will subside, and the Salt will crystallise each in its proper figure; the remaining liquor being thicken'd till a crust appears at top, will give crystals, but less pure; proceed with the remaining liquor, there remains water, which is not easily dry'd, but is fatty, saline and earthy; which being dried at the fire, runs and is sharp and acerb; and in all these operations Earth is afforded; and by repeated crystallisation and solution, the whole Salt flies off and leaves the Earth behind.

Let us distill these fossils, by mixing them with Bole or Earth; they are divided into an acid spirit, and Earth at the bottom; wash this Earth, and you gain a fixt Salt; redistill this acid spirit, and Earth remains behind; when we have rid these spirits of their Earth, they smoak and fly into the Air, as appears in *aqua fortis*, spirit of Nitre, and Glauber's spirit of Salt; hence both alkaline and acid spirits appear to be volatile, and are only fixt by Earth; mean while two things are to be observ'd, whilst the acid of Vitriol and burnt Brimstone is fixt in 56° of Fire, but by reiterated distillation becomes fluid and deposits Earth: This indeed may depend upon somewhat terrestrial, which can't easily be separated; again the most volatile acid Salts being united to alkali's, turn armoniacal; if then Alum has its Earth taken off, it becomes volatile; Calcanthum dissolv'd in Water and digested, affords Ochre, and by repeating

peating solution and crySTALLISATION most part of it is turn'd into a yellow calx, another part into an austere fat liquor, and the remainder vanishes in the Air, the calx may be remelted into brass or iron, according to the nature of the Vitriol; Earth itself concurs to compound Metals; I never got true Earth from Metals, for what can be vitrify'd is not Earth, but Metal.

Let us now examine sulphureous bodies: Such as Bitumens, Naphtha, and the like, which if burnt, afford Earth, as animal or vegetables did; Brimstone always affords something of Earth at first distillation, and tho' its flowers be resublim'd, afford little Earth, yet when mix'd with fixt Salt upon the Fire, and expos'd, a great deal of Earth settles: The Oil which is united to the acid, gives a great deal of Earth, and by the Fire it revivifies.

The ancients thought Metals were made of Quicksilver, and some other principle to make 'em ductile, but the moderns relying upon experiments, from analysis and composition speak of a vitrifying Earth as the basis of them; but I have never discover'd such an Earth. Quicksilver taken from the mines and put into a piece of leather and press'd, leaves Earth behind, if distill'd, it leaves fœces behind, which I dare not pronounce to be Earth; shut this Quicksilver up in a strong glass bottle, cork it well, tye it down with a bladder, and fasten it to one of the wings of a wind-mill, so that it may be thoroughly agitated, and it will turn into a black powder, which is true Earth, as some suppose; but as this can be reduc'd into Quicksilver again, 'tis the same body in a different shape, 'tis said to be good in ulcers, in an ill habit, and it is *Homburg's* experiment; neither are metals Earth, for they do always recover their former shape, or can be vitrify'd;

IRON

Iron indeed affords somewhat resembling Earth; Gold, Silver, Copper, Tin, and Lead prepar'd after a simple manner, and amalgamated with Quicksilver, and afterwards beaten together, do afford a black powder, which leaves after washing in Water a metallick substance; this being beaten again, affords the same powder; and this labour often repeated, which some would bring as a fair argument to shew that Metals were Earth, but I don't think this is Earth, only a metallick product, whose properties are admirable; if you seek for Earth in this powder, you'll be deceiv'd, but you'll find many things you did not expect; for Gold, Silver, and Quicksilver are still reducible by the fire; I can testify for Gold, that I've reduc'd it by acids into a liquor, have made it into a soft paste, and made it a calx several ways, it can be turn'd into an Oil, be chang'd into the form of butter, turn'd into glass and resemble Earth; yet still it was reduc'd into Gold again; and distilling Gold with Quicksilver, yet still it return'd.

Now let us draw the following Inferences; 1st, 'Tis the basis of all firmness, and gives solidity to bodies, and hinders things from flying off, and makes the structure. 2^{dly}, So that there is a great agreement among all the kingdoms, by each of 'em having this principle in them, since most bodies are found to have it. 3^{dly}, Bodies therefore having the same principle in them the changes are easily made. 4^{thly}, Iron having some Earth in it, is more safely given internally. 5^{thly}, Bodies that have Quicksilver for their basis, are not so readily to be given internally, being too heavy for the body. 6^{thly}, If neither Earth nor Quicksilver were in nature, could not every thing then turn to Atoms and fly into Air? 7^{thly}, Earths are fit for chymical Instruments. 8^{thly}, Salt wou'd fly off
were

were it not for Earth, for example, if Salt of Tartar flow alone in the Fire, and unless it pass thro' the pores, it remains long fixt, but if you mix it with three parts of Tabacco-pipe clay, it becomes all volatile; so Nitre by Earth becomes volatile. *9thly*, Earth serves to purify volatile Salts from their Oils. *10thly*, It hinders the expansions of viscous bodies, so that honey, blood, urine, and other bodies being mixt with Earth, will distill without swelling or breaking the vessels. *11thly*, Sand is not Earth, but small crystals can be united into glass; neither are boles nor *Terra sigillata* Earths, but compounded bodies, which some have call'd the fat of the Earth; in them abound Alum, Salts, Calcanthum and the rest, as has been discover'd; hence are they a Chaos of all elements. I cease to speak any more of Earth, having tir'd my readers with my great prolixity: However I thought these things necessary to be mention'd; I've given you a faithful description of the elements; I've told you what the Alchymists have said of 'em, at length I speak it without boasting or envy; I believe I may say, I've told you some things that were never heard of; you've seen that those things are very compounded, which are taken for the elements, which when pure are really such; to what does Fire, Air, Water, Earth yield to in simplicity, and consider'd in another light, what is more compounded; I've endeavour'd to say what is true and sound, if I have doubted, I've admonish'd you of it; what I've interspers'd of Metals, I had a mind some time ago to have conceal'd, but your presence and diligence invited me to speak it.

On M E N S T R U A.

Along, my pretty Hearers, let us chearfully pass on to another head; for as we have said enough and too much of the elements, let us now say as much of what *properly* belongs to Chymistry, and which is the chief part in it, and in which they justly triumph.

By a *Menstruum* is understood, that one body dissolves another, so as to be blended like one thing: Not when the dissolvent and dissolv'd recede from each other.

The name is from *Mensis* a Month, because the dissolvent and the body were kept in heat for a philosophical month (40 days.)

The nature of a *Menstruum* is to dissolve and be dissolv'd; the body that dissolves is intimately blended with the body dissolv'd, and there is a division of the dissolv'd into very minute parts; hence there is a difference between this division and the mechanical one, of a Knife, &c. and the Bread it cuts, &c. for these instruments are not divided, tho' what they cut, is; but now, when I think better of it, it seems to be the same thing; for the dissolvents, like Knives, &c. have their size, figure, hardness and weight, by which they cut, divide, and are contiguous to the body so divided, and seem to be united into one thing.

Menstrua are divided into fluid and solid, tho' so long as they are dry or solid, they can't be call'd properly *Menstrua*, however we retain the division.

To the solid *Menstrua* we refer all the Metals but Quicksilver; whilst they continue solid, they don't act, but if they are melted, they mix with one another; join 1 oz. of Gold with 10 oz. of Silver, this is 11 oz. give 1 gr. of this to a Goldsmith,

smith, and he will draw $\frac{1}{17}$ of a grain of Gold from the mass. Gold may be divided infinitely; if then I mix 100000 ounces with one grain of Gold, you could still get the hundred thousandth part of Gold from it, which is somewhat wonderful: Perhaps this was the reason why the Chymists heretofore suppos'd that Metals were only open'd by Metals. *2dly*, Half Metals, such as Antimony, Cinnabar, Bismuth, Marcasite, and Zink, are referr'd hither, for they can be fus'd and mix'd with Metals, and by their mixture make 'em brittle; Cinnabar is the most difficult to mix. *3dly*, Hither are referr'd all dry Salts, such as Alum, Borax, Nitre, Salt Armoniac, *Sal Gem.* Sea Salt, Fountain Salt, Vitriols, fixt Salts and sublimate; for these mix with one another, and with Metals. *4thly*, Hither are referr'd all Sulphurs, as Brimstones, Arsenicks, and Cobolt, which mix with one another and Metals. *5thly*, To this class are referr'd Cements, which exalt the colour of Metals.

Some of these *Menstrua* unite with the body, and appear to be but one thing, as Lead with Tin appear to be but Water mixt with Water, and seem to the eye as homogeneous; and the same may be said of Metals and Semimetals blended together, for mix a pound of Tin and $\frac{3}{4}$ of Regulus of Antimony, melt 'em upon the Fire, the mass is so brittle as not to be malleable, yet appears to be a mass all alike; so fixt Salt joins with Sand into glass, so Mercury with Sulphur into a black powder, which by being sublim'd, is Cinnabar; thus Vinegar pour'd upon shell powders, &c. unite into one hard mass, and in all these cases the dissolvent and the body to be dissolv'd, do concrete into one mass, which is every where alike to itself.

So much for dry *Menstrua*; Let us now proceed to the moist ones, such are Vinegars, Water, spirituous Liquors, acid and alkaline Spirits, fixt Salts *per deliquium*, &c. Some of these *Menstrua* before they begin to dissolve, are fluid, and continue so, this appears in the solution of Metals by Mercury, they make an amalgam or paste, which you may dilute with the Mercury at pleasure; which whosoever could make hard would be rich; so acids which dissolve Metals remain fluid, nor can they easily be dried; on this we need insist no further.

If we consider the action of these *Menstrua*, we shall find that in the time of solution, the body to be dissolv'd is made to enter between the particles of the dissolvent, and thus one compound is made, differing much from the nature of the simple body: 'tis therefore plain that this association or union depends upon the application of the dissolvent to the body to be dissolv'd, and that the particles of the dissolvent recede from each other, and are attracted to the matter, to be dissolv'd, or *vice versa*: Therefore this force is reciprocal, for in the solution of Gold in *Aqua Regia*, where the Gold is 18 times heavier than the *Aqua Regia*; were it not some such power, the Gold would lie at bottom, and the *Aqua Regia* at top; these mechanical actions therefore rather proceed from friendship than enmity, by which the parts are united; the struggles rais'd upon their mixture end in peace as soon as the parts are united; behold this diluted spirit of Nitre, 'tis at rest; behold I put this piece of Iron into it, behold what an expansion, heat, noise and smoak is rais'd; but behold this struggle lasts no longer than all the parts of the acid are join'd to all the parts of the Iron; behold also this struggle is not instantaneous but successive, and the reason is, because the sur-

faces are touch'd and attack'd successively: wherefore the struggle encreases every moment till the whole is over; the Fire assists this solution, what would become of all things if the Fire were absent, can hardly be defin'd, 'tis impossible quite to banish it, and solutions are slowly made in extreme cold.

However some require a large Fire for this purpose, as when Mercury dissolves Metals; some a gentle Fire, as when Salts are dissolv'd in Water; others a moderate Fire, as when an Egg is to be diluted in Water.

The Fire by its rarefying, dividing and moving power, makes the attraction the quicker and stronger, as may be observ'd in Salt Armoniac, dissolv'd in cold and warm Water (r): Therefore *Menstrua* introduce no change, but an union betwixt the parts, for let Metals be dissolv'd in any acid spirits, you can recover 'em, and return them to their pristine shapes; hence their essence is not chang'd, their particles are only divided; the same happens constantly, I have above fifty times dissolv'd Gold and Silver with Mercury, and have as often call'd off the Mercury, and left the Metals pure; thus Water can be call'd off the Salts; thus Oils from Salts; thus Glafs may be return'd into Sand and Salt, thus Sulphurs from Salts, or from Metals; thus Resins from Alcohol; but you will object that by *Menstrua* new bodies are made, as appear in *Sacch. Saturni*, where the Vinegar having prey'd upon the Lead, by distilling you get a brandy Spirit, which is true, but their connexion is too strict for all their parts to come off; examples of this kind are common, thus a Lancet will cut, but sheath'd will do no harm; as then the easier this Lancet can be unsheath'd, you may

(r) N. B. Why then are Crystals never made by Heat? The rule is variable.

the easier perceive what it is, whereas if it stuck very close and were connected inseparably, then all wou'd affirm that this Lancet was chang'd; a Cylinder of Silver gilded and put into *aqua fortis*, the whole Silver contain'd within that golden sheath will be dissolv'd, the sheath remaining; therefore if the acid be united to the Lead very strictly, it will not mount, however the Lead is not turn'd into this inflammable spirit, and therefore there is no change but an union (s). So that where *Menstrua* are not separated from the bodies, 'tis an argument of a strong connexion, and when they are, and the bodies seem to have chang'd their shape, this change is only in the figure not in the essence. From what I have said, it appears that these *Menstrua* act by motion, for without this the parts would remain in the same position.

But altho' 'tis very true that motion is the occasion of solution, yet 'tis hard to explain the modus; for as to propulsion, gravity, elasticity, or magnetism, 'tis in vain to seek it in them, wherefore this solution depends upon the action of the Fire, for whenever any solution happens, the Fire drives these parts against each other and keeps them there; other common solutions, as of Dust in Water, Oil in Water, Stibium with Salts and Metals, the Metal subsides and the Scoriæ immerge, so in fixt Salts and rectified spirit of wine, and such like, it appears to me that *Men-*

(s) This whole Paragragh might have been much easier prov'd; he starts an objection which he has by no means solv'd, 'tis true that the Acid and Lead are strictly united; 'tis also true that the Acid contains somewhat of a brandy Spirit, which coheres not so strongly with the Vinegar as the Acid does with the Lead, and therefore it mounts; but pour on any alkaline Salt, then this Salt attracts the Acid more strongly than the Lead; therefore from such a mixture you acquire a neutral Salt, and the Lead will soon return to its former shape.

hardness, figure, weight, and impulse, bodies are attenuated and divided, and then they separate, and this is the way to know a mechanical action (1).

As often then as any solution is made, these bodies are carried towards each other and remain mix'd, tho' of different gravities; hence we may say 'tis partly done by a mechanical power, and by some other secret and singular property in the dissolvent, by which they attracted each other.

Let us exemplify these assertions; suppose clay boyl'd in Water, the force of the Fire divides the Clay and mixes it with the Water, remove it from the Fire and the Clay subsides, this I call a mechanical solution; but if you take *sal gem.* and dissolve it over the Fire in Water, tho' 'tis heavier than the Water 'twill remain suspended in it, something therefore suspends this; thus Alcohol dissolves its like.

I shall divide *Menstrua* into four sorts. The first shall be on mechanical solution, the next shall be on *Menstrua* that cut by mechanical motion, and also by repulsion; the third upon mutual attraction, in the last order I shall range all those *Menstrua* that act in all these manners: This last has far the greatest share in *Menstrua*; I shall give you an example of several of 'em, first where there's a mechanical solution, granulation, where melted Silver is thrown into cold Water, and divided into small particles; in this case the Silver divides the Water,

(1) Pray what does this author suppose motion to be? Is it not a mechanical property of bodies? is it not an impulse? and altho' motion is not a constituent part of bodies, yet 'tis an affection which has its own proper laws: And these laws are mechanically and mathematically accounted for; 'tis not body but a *modus* of bodies, as an angle is not body, but a *modus* or inclination of one line towards another; and yet tho' this inclination is not body, it has its real properties, the same may be said of motion.

and

and is divided by it, yet after this each takes up its proper place; but if on the contrary you melt Copper and throw it thus into Water, there is such a repulsive force betwixt these two, that it will fly into a thousand pieces and prove dangerous to the by-standers.

The next example is, a dry and fluid body united by attrition and divided by attraction, as appears in *Æthiops Mineral* and in *Cinnabar*; you mix the Mercury with the Sulphur, and they unite; you force them up by a fire, they are still united, and they are *Cinnabar*; mix an attractive body with either of these, such as fixt Salt, Lime or Iron, the Sulphur fixes to these, and the Mercury mounts up pure.

Next I take Antimony, put it into a Crucible and melt it, it separates into two parts, into a metallic *Regulus* at the bottom and *Scoriæ* at the top, so that the fire has repell'd the *Scoriæ* from the *Regulus*, and made each attract their own Particles.

I shall shew you another example on dry *Mens-truums*. I take salt of Tartar one oz. flower of Brimstone half an oz. mix them and melt them in a Crucible, they run into an Oil; I also mix Antimony and salt of Tartar and put them in a Crucible, they unite into glass. I take one oz. of Silver and three oz. of Brass, put them in a Crucible, melt them, they unite into one metal, and are hard to be separated without lead, in the Cupel; the fire therefore mixes them together intimately; in this case the metals do not divide, but are united: You see therefore the various manners of drying *Mens-truums*.

You will now have a different Idea to what the ancient Chymists had of *Menstrua*, for when they saw a corrosive body corroded a harder and not a softer one, they were puzzled, not considering

strua act mechanically, when by their magnitude, their principles were not the occasion of action but the mechanical ones.

Fire is the universal dissolvent, for there is no body but will be dissolv'd by some degree of heat, the greatest melts bodies and vitrifies them.

We must take trituration into our views, this often supplies the defect of fire; so *Langelot* has said to have beaten Gold into a potable liquor, and *Homborg* has prov'd that Gold can be dissolv'd in Water, if well beaten together.

3dly, Let us consider the fire and trituration together: Let Mercury and Lead be put in an iron spoon, 'twill be an amalgam, beat this in a mortar with a glass pestle, it affords a blackness, wash it this blackness goes off; let this often be tried, that blackness still returns, and the water washes it off; and the same happens if it be distill'd, but *Harpocrates* seals my lips.

4thly, Besides these nam'd, attraction come in play; let the former example of an amalgam suffice, where the particles are united strictly after they expell'd each other.

5thly, The body appears in another form when the attraction is dissolv'd, and generally appears in the form of a calx; hence solid *Menstrua* act as fluids, and attrition performs the same office and alone fits a body for solution.

I will now give you an experiment in which all these causes, viz. Fire, trituration, repelling, and an attracting force, as well as mechanical action, concur all together in dry *Mensstruums*, so that all the effects of attenuation, concoction, mutation, and separation follow together. Take Antimony 16 oz. Tartar 12 oz. Nitre 6 oz. powder them apart; observe, turn your eyes this way, here's an iron spoon which is made very clean, into this spoon made warm I put Tartar and Nitre mixt together

together, put them upon the fire, they sparkle and flame, and become a fixt Salt; and as Sulphur, Nitre, and Tartar being mixt and thrown into a red-hot Crucible and become an alcalious Salt: Being thus instructed, pray, in God's Name, let's now see what will become of Antimony mix'd with Nitre and Tartar; put them into a hot Crucible after they have been warm'd, they will presently detonate; thus throw in gradually more of this powder after every detonation is over, till all is thrown in; put this into a brass Cone besmear'd with candle-grease, you will find the metallick part at the bottom, shining like Silver, and the scorixæ at top: 1st, Here is trituration of the matter into powder; 2^{dly}, they are put upon the fire to mix them; 3^{dly}, the oil of Tartar and the sulphur of the Antimony join into one body by attraction; 4^{thly}, the scorixæ and regulus are repell'd from each other, therefore mechanical force, attraction, and repulsion are all join'd together. 1. The Crucible must be very large; 2. it must be red-hot before we put in the materials; 3. let the detonation be over before we put in any more; 4. let it flow like water before you take it out; 5. you must warm the Cone before you put in the material; 6. you must anoint the Cone with candle-grease, which is better than oil. If these things are not observ'd, the operation will not succeed.

These being premis'd, let us proceed further; no body is so hard but it can be divided, Jewellers can polish Diamonds into different figures, and cut 'em with a saw mechanically; soft bodies can dissolve hard ones, as Water a Stone, Leather polishes Glass, a wooden wheel by circumrotation will powder hard bodies.

Bodies that appear to us very soft are yet very hard in their component parts, so Fire, Water, Air, acid Spirits and Alcohol, are in themselves

immutable, and do penetrate the hardest bodies; and *Homborg* that most diligent searcher of nature found that acid spirit in many years was not changed. *Hamel Hist. ac. reg. sc. p. 497, 498.* Only Vinegar changes its nature: These things prove that what appears to us to be soft, by friction and application will destroy the hardest bodies; other bodies don't act so strong as Fire, because they recoil often; gravity also contributes to these effects, which the stronger 'tis, the greater will the effects be; this strong pressure or application of a soft body to a hard one, appears in *Papin's* digester; (*u*) we see then how attrition dissolves bodies; we must then next observe the conditions requisite for solution. 1st, One condition is the *fineness of the pores*, and the bodies that are to enter those pores, if those entering particles are too large, they can't enter; I shall bring you an example of this kind; I take the strongest oil of Vitriol, put filings of Iron into it, it moves gently, but add Water to this oil of Vitriol, and they effervesce and swell violently; in like manner, put filings of Silver into the strongest spirit of Nitre, they are not mov'd; put some Silver into strong spirit of Nitre, add Water to it, they are not mov'd in the cold; put Silver and Lead into the strongest spirit of Nitre, and they are not mov'd, tho' the Silver will be corroded if you add Water; put red Lead into spirit of Nitre, and they are not mov'd in the cold, nor do they effervesce; dilute this spirit of Nitre in which the mixture is with Water, neither are they mov'd;

(*u*) *N B.* This impulse is not gravity, therefore this paragraph is ill join'd: and something is infer'd which was not in the premises; his argument is this, gravity has a great effect in solutions, therefore impulse has a great effect: Elasticity gives a great impulse, but elasticity is not gravity.

add

add the Fire to them, and they all begin to work
1. then, Acid spirits can be diluted. 2. Concussion promotes this dilution. 3. So many watry particles can be added as the artist pleases. 4. It may be that these particles may not unite by reason of the dilution. 5. 'Tis these saline particles that enter into the pores of the bodies. 6. These acid particles were too strongly united till they become diluted.

2dly, *Figure* contributes extremely to solutions; thus 'tis, that, as *Mr. Boyle* has observ'd, the webs of the key are fitted to the lock; so the figures of bodies are fitted for solution; so a bell is fitted for sound, for being struck it vibrates the Air into innumerable elliptical waves from every point of the circle, and this depends upon the shape of the bell (x). If we make use of dulcify'd spirits of Vitriol, of Nitre, or of Salt, their effects will be very different to what they were before; 'tis to be observ'd if to one ounce of oil of Vitriol you put six of Alcohol dropping it gently in and shaking the glass after every drop put in, distill these gently till the mixture grows black, then change the recipient, there will distill a choaking sulphureous phlegm that raises a cough, and along with it a sweet oil of *Calcanthum*. *Hoffman. Obs. Phys. Chym. (y)*

3dly, Rigidity is another condition for solution, for by it the body dissolving, enters as so many wedges into the minute pores.

4thly, The last mechanical cause of solution is Fire; this tosses and moves bodies effectually; a

(x) It is somewhat peculiar, that this author assigns no reason for the sound of a bell but its figure.

(y) N. B. Does the spirit of Wine and oil of Vitriol, mix'd and distill'd according to *Hoffman's* directions, prove any thing relating to the figure of the body? No surely.

wedge

a wedge is not driven in without a hammer: Nothing, whether Figure, Gravity, Hardness, Size, or Elasticity will act without the Fire; this makes all to go forward. These, my worthy comrades, are what are drawn from the mechanics to explain the action of *Menstrua*, but these are not sufficient.

Hence mechanical properties are not the cause of *Menstrua* dissolving bodies, but *Fire* that moves, agitates and tosses all things around, is a main instrument of these solutions, as also may the Air; bodies by their gravities press upon bodies, figure does not enter, and in short nothing acts without this universal agent; we see *Hartshorn* is not dissolv'd so much by coction, as a steam, and fire by diluting enters and tears bodies into their minutest and component parts. They who have therefore publickly affirm'd, that I undertook to explain all chymical events mechanically, impose upon the world; none is further from this opinion than my self (z).

We shall now proceed to examine the various sorts of *Menstrua*; and first of *watry Menstrua*, Ice is a *Menstruum* that is dissolv'd by, and dissolves salts and spirituous bodies. Water however is properly a *Menstruum*, when it is fluid and just

(z) Pray what is *Motion*, by which Fire acts, but a mechanical affection or mode of matter? Are there not certain laws of motion, which are every day found out or better explain'd? This state or mode of matter is call'd *Impetus* or *Velocity*, and it is not a part of matter but an effect of an impression or impulse given from an external or moral agent, which impulse continues till it meets with an obstacle; hence a projection made, when there is no medium or attraction to resist, wou'd be perpetual, let it proceed from what cause we please; now tho' Fire is a natural agent, that has receiv'd its impulse from the Almighty Hand, this does not hinder us from finding out its properties, nor from calling its properties mechanical.

freed

freed from freezing, viz. at 32° ; from that degree a hoary frost begins, and *Romer* 1709, observ'd the winter cold to have settled the glass, which he was inventor of, to 1° so that it settled 32° below Frost at *Dantzick*, which is 40° Lat. and doubtless near the Pole it was colder (a).

Water is a *Menstruum* from 32° of heat to 212° , when it boils; then it can be no hotter, unless the compression of the Air be greater or it be nearer the centre.

It is the happiness of this age, that I can't enough congratulate, that they have found out, that Water in each degree of Heat from 33° to 212° , when it boiles, dissolves more salt every degree, till it refuses any more; and as it cools, in each degree it drops parcels of salt till it freezes and drops all its salt; which however, when it thaws and heats it resorbs, and dissolves again, as you see to the eye, which convinces us of the truth.

From all these, it is evident, 1st, That the Salt and Water were only contiguous, and neither of this nature were chang'd. 2^{dly}, Heat quickens the solution, and causes more Salt to dissolve. 3^{dly}, That cold thickens the mixture and causes the Salt to subside. 4^{thly}, The Salt crystallises, but upon the Heat returning it dissolves again, and oil of Vitriol itself congeals by cold. 5^{thly}, When Water has dissolv'd, by being boil'd, as much Salt as it can, 'tis heavier than Water, and Brine is hotter than Water, as is try'd by the glass, when 'tis boil'd, and Brine requires more heat to boil it than Water, as you see. 6^{thly}, Hence Fire is the cause why Water is a

(a) I thought *Fahrenheit* invented this Glass! What is this freezing here to the fluidity of Water, by which it is properly a *Menstruum*?

Menstruum,

Menstruum, as freezing shews us; which begins at 32° to 72° , and every degree more Salt subfided, till spirit of Nitre itself turns into crystals, and the same cold hinders Water from dissolving Alcohol; for I expos'd in 1720 in the utmost cold, Beer, Wine, Vinegar, Brine; the strong Frost caus'd the Water of these liquors to turn into a soft Ice, but the spirits of these liquors was united and stronger, as I try'd, and the stronger the Frost grew, the stronger were they. 7thly, Hence heat is necessary to make Water keep its contents from settling; these things apply'd to us and our humours, will have their use, which has been little thought of; Water then, which is the greatest ingredient in our blood, is subject to change from the weather; and urine, settling from cold, if you warm it, resorbs all its sediment.

One wou'd believe from hence, that Water as it heats wou'd always serve as a *Menstruum*, but the contrary appears, for warm Water dissolves Paste, whites of Eggs or Blood, but boiling Water hardens them.

The following are always dissolv'd in Water, 1. all natural Salts, as Nitre, &c. 2. all alkaline Salts, fixt or volatile; 3. all acids whatever; 4. all neutral Salts, tho' *Tartarus vitriolatus* is the hardest; 5. all *Borax's*, but with difficulty. 6. All essential Salts, of Plants. 7. All Tartars, but with difficulty, and they soon crystallise if the Water is evaporated; nay all Salts, except Borax, Nitre, Tartar, Tartar vitriolated, can hardly be kept from running; alkaline Salts run presently and attract water; oil of Vitriol sucks in Water greedily, Salt of Tartar hardly is to be parted from it, yet mix'd, they hardly dissolve; so in most mix'd Salts: It also dissolves saline bodies, as juices of all Plants or Trees, as Cassia, Manna, Honey, Sugars, and all Soaps, animal Juices, except

except Fat, Bile, the *offa Helmontiana*; Salts attract Water and Oils, Vitriols of all Metals; 'tis this Water that dilutes the Vitriols of Metals, and makes them mineral Water, 'tis this that makes Brass blue with Salt Armoniac, which when evaporated the Ochre or Copper drop; but Butter of Antimony, tho' a Vitriol, does not dissolve in Water; Earth thus dissolv'd in acids, will swim in Water, as Chalk, &c. but Glass will not, nor a human Stone; these being Earths made up with alkaline Salts. Hence it appears how acids help to dissolve our nourishment, it is in our stomachs, but afterwards our blood turns alkaline, or our bones might be in danger, for *Ruysch* has often told me that bones put into acids grow soft and flexible, but do remain firm in Alkali's; hence in Rickets acids are bad, hence let care be taken that acids be not us'd to clean our Teeth; also Sulphurs mix'd with alkaline Salts will dissolve in Water; we have seen a *Panacea of Antimony*, which I discover'd, made of Antimony finely powder'd one pound, oil of Tartar or *Alcalibest Glauberi* two pound, digest, a red Tincture is given to the Salts, which tastes fiery, and is warming and diaphoretick, but common Sulphur wou'd do the same, for the Sulphur of Antimony and common Sulphur don't differ in virtue (b). Nay Antimony will give a Tincture to volatile Spirits, Mr. Boyle's Refins will also be dissolv'd in Water by alkaline Salts, fixt or volatile; hence putrefied Urine, burnt Wine Lees, Soaps, Sugars, Honeys, Choler, Yolks of Eggs, mix these

(b) I can't think so, our *Æbiops Min. Antimon.* is stronger than common *Æbiops*, and pray why do *Sibium* and salt of Tartar calcin'd prove caustick, nay, in a Tincture with spirit of Wine rectified, they are also caustic, p. 778. Vol. I? but because Salts open the Oil.

Resins with Water. As to the secrets of authors I know them not, *Helmont* boasts, but too boldly. Having now spoke of Water as a dissolvent, it remains I shew what are watry dissolvents.

Hail and Snow relate to Water, and these are Waters, which are pure; and Snow, as I have often said, is pure Water, if gather'd from a high place, and distant from any Town: Dew is the most compounded of all Water, and is a chaos of all things.

Of OILS and OILY MENSTRUUM.

I have already said what Oils are; there are different sorts, some are made by coction, others by expression, or fusion, as Pitch, or distillation, by exaltation or descent: Distill'd Oils don't congeal, express'd ones do; I have consider'd the difference of these Oils, but must rely on experience to determine it: This we know, that they will burn in Lamps; they prove *Menstrua* when they are thaw'd; and as some of them freeze sooner than Water, they are not so good dissolvents as Water: Those which always keep liquid, do always retain a dissolving property, as Oil of Linseed.

Most Oils don't boil till they arrive at 600° of heat, except the rarefied one, as *Ol. Tereb*; and as Water boils at 212°, therefore Oils are hotter when they boil than Water, and as they grow hotter, they prove better *Menstrua*: Water boils at 213°, Alcohol at 175°, but Oils of Turpentine and of Linseed don't yet boil, in *Fahrenheits's* Thermometer with Quicksilver; 'tis not levity nor volatility then that makes liquors boil sooner: Brine boils at 218°, Oil of Turpentine boils at 560°; however, when this Oil grows thick, 'tis longer e're it boils; and the thicker 'tis, the longer

er 'tis e're it boils; Oil of Almonds boils at 600° and more: The power of Fire over Oil is to its power over Water as 10 to 3; Water freezes at 33° , but Oil does not freeze at 1° ; the middle term of Water between freezing and boiling is 180° , but of Linseed Oil is near 600° : Who would have known all this *a priori*!

Oils preserve bodies, tho' in the greatest natural heat, and bodies remain incorruptible in them; and if bodies be thrown into them whilst the Oils boil, they crust them over yellow, red, or black, and thus Meats may be preserv'd for ever.

Hence these *Corollaries* may be drawn.

1st, The degrees of heat given to bodies by fire are not in a Ratio of the Densities of heated bodies.

2^{dly}, However, the denser a body grows by consolidation, this fire may be more communicated to that body.

3^{dly}, The power of the greater fire to be communicated to any body does not depend on the combustibility in fire; boiling alcohol admits no more fire or heat, than which nothing is more combustible, and nothing in nature admits less fire than it; so far that we see it is in vain to seek for generals, we must try each particular properties of bodies; from hence many things may be gather'd, to wit, that we may dissolve Metals in Oils, so that 'twill be hard to separate them again: Red-Lead in powder thrown into Oil, boil, the Red-Lead is dissolv'd, it is a metallick balsam, and a cement to keep out Water; so granulated Lead half an oz. Oil Olive one oz. and half, also dissolves and runs Tin, and Lead and Tin together do the same, before the oil boils; melted Lead burns less than boiling Oil, because it melts with less fire than is requir'd to boil Oil; however, take care no Water falls into the Oil whilst

whilst it boils, lest it fly about and do great mischief.

Hence, 1. Oils have in them much fire e're they boil: 2. No liquid contains more fire than it does, for Oil of Vitriol, Lixivia, boil sooner, so does Quicksilver: 3. They hold much fire, e're they'll evaporate: 4. Oil communicates its heat to other bodies, and Lead and Tin melt before it: 5. It communicates its fire to Tin and Lead contain'd in it: 6. We know no other way than fire to communicate most heat to it, unless by compression added, hence it would receive more heat at the centre of the Earth; if Water should then fall into boiling Oil, Vulcano's would be bred: 7. The vessels containing it can be no hotter than the Oil, which hinders their growing hotter: 8. God then has bounded the fire, that the Oil should not expand immensely.

Crude Oils have much Water in them, they crackle in boiling, and their steams are Water: They also contain in them a hidden acid, as the smell and distillation convince us.

We are to consider whether the effects are produc'd from the Oil, or from this Water and Acid; for paints boil'd in Oil dry sooner, but if you paint with crude Oils, they never dry: Oils put into Brass or Iron give a colour; Guns and brass Materials are defended from rust by boil'd and thicken'd Oils: *Boyle* and *Hoffman* observe, that put Salt of Tartar to Oil and you get a *Tartarus Vitriolatus*, and distillation shews the Acid plainly.

We must separate the foreign parts from Oils, before we know how to descry their effects.

Before we recommend Oils for *Menstrua*, we should examine how far they may be call'd Oils: Fetid or aromattick Oils distill'd, tho' 14 times, leave Earth, but become thinner, and a different
Menstruum;

Menstruum; *Helmont*, *Hoffman*, and another brag-gadocio, say good things of the Oil of human Blood distill'd, often distill'd with Spirit of Salt. See *R. Lully* and *Jf. Holland*.

There is in Oils, and in no other body, an *Archeus* or *Spiritus Rector*, (c) which if evaporated, the Oils are vapid and dead; one thing observable is, that Oils are capable of retaining much fire.

Oil then mix with Oils, not easily with Oils of Turpentine or Amber, from the difference in weight, thickness, &c. 2. Refins melt in Oils; 3. Gums; 4. Balsams, Colophonies; 5. Sulphurs, solid or fluid; so Antimony in powder or flowers makes a Balsam, the Regulus being untouch'd.

Of ALCOHOL or SPIRITUOUS MENSTRUUM.

Our Alcohol (d) is the same as that of the adepts, for it does all that theirs did, except dis-

(c) *Helmont's* Term, he says, *Ens Calicum in se habet*, p. 588. Col. 2. he compares it to Salt Armoniac when it is apply'd to Spirit of Nitre, p. 89. Col. 2. No. 41. he calls it in the same place a Gas; he says in the same place, *neque enim in guttas cogitur, eo quod ex sanguineo arteriali cogitur*. P. 381. C. 2. No. 26. he says, *Nisi res per saporem & odorem Archei arriiserint, non intro admittuntur*: In the same place he says, *Alius proinde gustus lingua & alius in stomacho, velut Archei extremo*. P. 116. No. 60. he calls it, *aura corporalis* and *vulcanus*; he says 'tis material in Minerals and a thick liquid, and in Plants it is more lively and liquid: In Quadrupeds it shines and fluctuates, so those Eyes which when in a living Body shone, when dead lose that splendor, and therefore calls it *Solar*; he calls it p. 121. an *Aura*, *vita Custos*, & *transmutationum promotor*; that all Diseases begin at the *Archeus*, and seize upon the *anima sensitiva*, and the *Archeus* which is the janitor of this Soul, &c. from all which we may gather his *Archeus* to be somewhat *volatile*.

(d) Alcohol seems to proceed from אלֹהִים *Deus*, and כֹּחַ *potens*, as if it were *omnipotent*.

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solving fixt Salts; 'tis subtil, volatile, inflammable, extracts sulphurs, preserves bodies, &c.

However Alcohol, if you put dry Salt of Tartar to it, makes a tincture presently; all know it is prepar'd by fermentation and repeated distillation; it is a true and effectual *Menstruum*; animal and other Oils may be so attenuated as to mix with Water like Alcohol, but not so well; yet it contains Water, Oil, and Acid, tho' ever so highly rectified. 1. It dissolves Water; 2. Wines, Spirits, Vinegar; 3. Oils; 4. Resins; 5. Gum-Resins; 6. Salts volatile; 7. fixt Salts; 8. Soaps; 9. Sulphurs dissolv'd in fixt Salts; but it does not touch neutral Salts, Earth, Sulphur, Quicksilver, Metals, Semimetals, Stones, nor Gums.

Of ALKALINE and ACID MEN- STRUUA.

The word Spirit is an ambiguous Term, it signifies volatile, acid, and spirituous Liquors; we divide saline Spirits into Alcaline and Acid; Spirit of Salt Armoniac is a volatile Alcaline Spirit, we get such Spirits from Animals and acid Plants, when pure it is separated from the Oil; Acid Spirits are Oil of Vitriol, Spirit of Sulphur, &c. These are all Salts.

Alcaline Menstrua are necessary to be understood, being some of the chief *Menstrua*; I have diligently taken pains to discover what's useful in them, to impart it to you. Salt then is what can be dissolv'd in Water fus'd in the fire, if it flies not off, and gives taste to bodies: The figures of Salts, as to their component parts, are not to be discover'd by the Microscope, but unite into various figures when join'd into Earth, &c. 'tis therefore difficult to discover their virtues; give me leave to mention their various differences: Salts then

then are divided, 1. into fixt Alcalies; 2. volatile Alcalies; 3. native Acids; 4. fermented Acids; 5. vegetable fermented Acids; 6. vegetable Acids prepared by combustion; 7. vegetable Acids prepared by distillation; 8. into fossil Acids prepared by distillation; 9. natural Salts, as Borax, Nitre, fossil Salt, Salt Gem, of Fountains, of the Sea, armoniac Salt; 10. Salts compounded of these: Of all which in order.

Of the fixt Alkali as a *Mensstruum*. The word *Kali* (e) signifies a certain saline Plant, which burnt gives ashes that have a great deal of Salt in them, which we make as we do other common fixt Salts: This Lixivium is from *Lix*, Ashes, these Salts therefore are call'd Lixivial or Alkaline Salts; some also call it *Rochetta*, *Soda* or *Zoda*; with this Salt and Calces are made Fritt, from whence is made Glass; they also make Soap with Lime and Oil: These Salts are brought from *Alexandria* and *Tripoli*, and as our Senses give us all our information, I shall give you the marks of fixt Salts; 1. 'tis got from an Herb; 2. made by Fire; 3. where it continues long; 4. it runs in the Air; 5. it tastes acrimonious and fiery; 'tis not urinous, but when tasted from the mixt Salt of the *Saliva* 'tis made so; for, 6. it has not naturally an urinous smell; hence does that smell proceed from the Acid fixing upon the fix'd parts and letting the volatile free; (f) 7. they turn

(e) It signifies burnt, for, *℥p* is *tostum*, or calcin'd; and to speak a Truth, the more volatile are Salts, the more do they recede from an alkaline nature; this plainly appears in a common Example, for Salt of Tartar attracts the Acid of Salt Armoniac, and takes possession of it forcibly from the volatile part, which had enjoy'd it before.

(f) This is a grand mistake; fixt Salts do not turn urinous with Acids, for they are only made so by the further attraction: But the 6th Section clears this up.

neutral Salts by Acids ; 8. with Turnsole, Roses, Violets they turn blue ; 9. applied for some time they will inflame and spacelate the parts ; 10. they are deterfive.

Such fixt Salts are made of all Plants, except those which have an acrimony or a scent.

They were known of old, for *Aristotle Meteor. C. 3.* mentions they burn the ashes of Reeds and Rushes, and boil'd in Water afforded a copious Salt ; and *Varro* says the Inhabitants of the *Rhine*, for want of Sea and Fossil Salt, us'd a coal of Wood made into Salt. *Pliny* says, those Ashes taste like Salt ; that the dregs of Wine burnt taste like Nitre, as did the ashes of burnt Oak ; and he says, that the lye of Ashes being drank is medicinal ; therefore the making of these Salts is not new. Since these Salts arise from the burning of Vegetables, how much must the Earth abound with them ! and in *Ormus* there are pillars of such Salts ; and as these Salts run in the Air and become neutral Salts thereby, therefore the Earth does not abound with these, but nitrous Salts, which contribute to vegetation.

These Alcaline Salts are never made but by burning, for if Plants be kept till they rot, they afterwards afford none of this Salt, they are not therefore natural. (g)

These Salts are compounded of Earth, Acid, and some Oil, along with a small quantity of Water made to cohere by the Fire, these Alcaline Salts do differ from each other according to the various mixtures and proportions of those mix-

(g) Vitriols are precipitated by alkaline Salts only ; we know of none but fix'd and volatile, wherefore we must either call that Salt which is in Vegetables, a fixt, a volatile, or an alcalifate Salt, but an alcalifate Salt is referable to none but the two above-named, and is an alcali *in potentia*.

tures,

tures, I shall recite the various species of 'em; 1. Pot Ashes are brought from *Russia*, they are made from the Ashes of Wood burnt, lixiviated, evaporated, and kept long in the Fire, by which they turn very acrimonious, which will run in the Air, which will with Sand make Glass, which expos'd to the Air often will leave a great deal of Earth and turn volatile; they are call'd in Latin, *Ciner. Clavellati*, because the Woods, out of which they are made, are cut into *Clava's* or Chips: 2. Tartar which is the Salt of Wine, press'd out from the dregs, or the dry Tartar of various colours, which if distill'd gives acid Spirits and Oils, and at bottom is left an Alcaline Earth or black Tartar, which burnt, lixiviated, &c. become Salt of Tartar; these Salts, if join'd to any metallic parts, give different colours to Glass; 3. the fixt Alkali of Nitre, which is made by letting Salt-petre flow, and throwing in Charcoal gradually till it will detonate no more; there is something particular in Salt-petre itself, for pour oil of Vitriol upon it, and it smoaks and affords an *Aqua fortis*, this Salt has all the qualities of other fixt Salts; 4. a fixt Salt is made of Tartar and Nitre, powder'd and detonated, which is also known to be Alcaline by all the aforesaid marks; however if you wou'd make a *Tartarus vitriolatus* from hence, the Nitre betrays itself by the smell. *Hoffman*, p. 231. Lastly a fixt and fiery Salt is made out of Salt-petre and the Regulus of Antimony, which is not to be born with, nay even a Tincture of this Salt with Alcohol is caustic; Nitre never grows alcalious with Sulphurs, but with the Regulus 'tis presently made: Alcalious Salts by fusing in the Air do attract Waters, and do hardly part with it under 600° of heat; one ounce of Salt will attract three ounces of Water and no more; hence this quantity must be supply'd from

six cubic feet of Air, supposing the weight of Water to that of Air, to be as 1000 to one, and a cubic foot of Water to weigh 64 pound, then all the heavy parts in a cubic foot of Air are $\frac{1}{12}, \frac{1}{8}$ of a pound, let half of this be Water, then in a cubic foot there's half an ounce; the more they are calcin'd the stronger do they attract it; *Sennivogius*. This I tried another way, by shutting up fixt Salt in a glass Jug, quite dry'd; I stoppt it with Cork and ty'd a bladder well moisten'd in Oil over all, and the Salt had attracted, even in the warm Air, as much Water as was in the Jug; these Salts repell Air, for try oil of Tartar *per deliq.* in the Air-Pump, and you can get little or nothing from it, or however they attract it so much that they will not part with it; fixt Salts red hot from the Fire unite with Alcohol, which if you suffer to attract ever so little Water, 'twill not do; all these Alcohols have somewhat of Acid, or make a neutral Salt, which is a *Sal purgans Sennerti*; we can rectify spirit of Wine by Tartar, which absorbs the Water and the grosser Oils.

These Salts will attract distill'd Oils and make a Soap, but then the Salt must be dry, and these Soaps have a deterfive and an opening quality, they also do attract Oils by expression if mix'd with Lime.

These Alcalines do also attract Acids more strongly than they do Water, and make bubbles, and repell the Water; you can hardly deprive oil of Vitriol of its Water, but by fixt Salts, which then make a *Tartarus vitriolatus*, and this attraction varies with the differences of the Salts. *Homberg ac. R. Sc. T. S. p. 52.* says an ounce of salt of Tartar join'd to 14 ounces of spirit of Vinegar, and exhal'd, increase 3 drams in 36 grains, the rest was Water with spirit of Salt 2 ounces 5 drams,
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it weigh'd 3 ounces 14 grains, with an ounce of spirit of Nitre it weigh'd 2 ounces 2 drams 36 grains, with an ounce of *aqua fortis* it weigh'd 2 ounces 2 drams 36 grains, with an ounce of oil of Vitriol it weigh'd 2 ounces 5 drams. Hence the Acid in these bodies was not pure, till this mixture and exsiccation; 2. hence if the whole Water of spirit of Vinegar cou'd be evaporated, it wou'd be as strong as oil of Vitriol; 3. hence the quantity of Water is known in these Acids; 4. hence 'tis probable if the whole Water could be taken from these acid Salts, they wou'd be dry; hence may be understood why Alkalines and Acids huff so: when they huff no more, that is call'd the point of saturation, and the Salts then become neutral; hence Acids are call'd Males; Alkali's, Females; the Air and Water are expelled, and the Salts associate; do Acids abound with, and Alkali's want Air? Are Acids abounding in Animals, flatulent? Are mixt Salts less flatulent? Do Acids alone raise fermentation? Are they the reason of this motion in fermentation? does fermentation tend to an Acid, and ustion make Alkali's? Does fermentation want a small heat to breed Acids, whilst a great one breeds putrefaction? Hence Alkali's and Acids breed motion in nature; the Air and Water are expell'd, and these Salts join into crystals and into a powder, easily to be dried by the Fire, which the Acids or Alkali's do not alone; the force of the Fire separates them again, but not into those saline principles from whence they were generated, this is true in Salt Armoniac sublim'd, *Tartarus vitriolatus*, Sea Salt regenerated, Tartar and Nitre resuscitated; but there are ways by which they may be separated. Alkalines attract one Acid stronger than another, which we prove by experiments, saturate an Alkali with Vinegar, or let spirit of Nitre be pour'd

to *Tartarus regeneratus*, spirit of Salt of Sulphur or Vitriol will do, the Alkali attracts these and lets go the Vinegar, which may be easily call'd off by a little Fire; to an Alkali impregnated with spirit of Nitre, -pour spirit of Salt, an *Aqua Regia* ascends, and the mixt Salt remains at bottom; if to Alkali you pour spirit of Salt so as to make it a common Salt, pour spirit of Nitre, distill, you get an *aqua regia*, and nitrous Salt differing from Salt or Nitre, remains at bottom, both repel each other and ascend, and both remain impact in the alcalick Salt at bottom; if with this Alkali sated by spirit of Nitre, you pour oil of Vitriol, the spirit of Nitre ascends pure, and you've a *Tartarus vitriolatus* at bottom; if to spirit of Salt or common Salt you put oil of Vitriol, you presently gain a spirit of Salt, which smoaks till it be redistill'd; hence the assertion is true and holds so in all cases; therefore the strongest attracter remains, therefore the Salt at bottom is a neutral one; 4. there is a great difference between these factitious and the natural Salts, for example, *Sal mirab. Glauberi* from *Tartarus vitriolatus* and the like; hence chymists are mistaken, in saying that these factitious are the same as the natural Salts; 5. when one Acid expels another, 'tis done without an effervescence, and therefore no Air is produc'd, which was indeed expell'd before, hence such changes and regenerations of acid Salts unheard of, which however can't be explain'd by any other principles.

Hence the following problems. Do Alkali's owe their origin to Fire? Do volatile Alkali's owe their rise to the heat of putrefaction? Can any Alkali expos'd to the Air remain long so? Do not Alcalies by meeting with an Acid turn neutral? And with oil of Soap? Does not the same thing happen in plants and human bodies?
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Are not compound Salts produc'd every day? Are not compound Salts the most common of any, as *Tartarus regeneratus*, the Ophthalmick spirit of *Mindererus*, Salt of Fountain, *Sal Gem*, Sea Salt or Nitre? Do not these arise from an Acid and a fixt Alkali of Plants? Are not these simple Salts rather chang'd than divided? *Franciscus Travaginus* the *Venetian* and the famous *Otto Tachenius*, will have it that these Salts proceed from an Acid and an Alkali; but I think the Sea-Salt was prior to either Acid or Alkali; no one hitherto has been able to draw an Alkali from Sea-Salt, which I prove thus: Salt with Bole gives an acid Spirit, the remainder at bottom is saltish, wash this Salt off with Water, depurate this with straining, make Salt of it again, I found it still Sea-Salt nor any Alkali in it, nor is there any Acid to be got from the Sea-Salts by Art; I confess that these Acids being pour'd to Alkali's give regenerated Salts, which come near to mixt Salts, but there's always a difference 'twixt the one and the other, we must therefore take care when we alcalise *Menstrua* to be very circumspect.

Take fine Sand or Calx of Flint beat into fine powder 100 parts, Alkaline Salt 105 parts, mix them nicely together, put 'em into a Glass Furnace for an hour, so that they be intimately mix'd, encrease the Fire for five hours, mixing them all the while, this is the Frit for Glass, set them by for four or five months in a hoghead, so that they may mix perfectly, put this into a Glass Furnace they will make an unctuous Fluid, whilst they are melting they always throw up a scum, which must be taken off, keep 'em in fusion for two or three days; this matter the Glass-makers call their metal, which when cool'd is the best Glass; who would have thought this? The Alkali flows like Water upon the Fire, and makes the
Flint

Flint flow, the concretion is so much the stronger as the solution was more perfect; here the Alkalies lose their nature, in Glass one 3d part is Alkali, but the nature of it is chang'd when it turns into Glass, where there is no taste of an Alkali, nor any taste, no effervescing with Acids, it becomes very mild and more fixt after it goes into Glass, nor so easy to melt, and becomes when made Glass so ductile that you make images of it, will stick to the Iron Pipes and becomes very pellucid like Water; on which no Salts have any power; this is the last operation amongst Chymists: The *Alcabeſts* has no power over it; don't we see the difficulty of explaining physical operations, suppose natural Philosophers had never seen Glass, what wou'd they think of it? Who wou'd have thought that Alkali and Calx of Flints would have made Glass; what then do Philosophers undertake to do, when they would explain the nature of Crystals and Diamonds, they must confess their ignorance, for they must know the nature of Fire, and the principles the bodies are made of, before they can pronounce.

Something adheres of an Acid nature to Alkali's, and the same may be said of Oils and Earths; according to which Principles we may know the varieties of Alkali's.

These Alkali's are so greatly inforc'd by an addition of testaceous or terreous bodies, that lime and they do make a strong caustic, as we see in the common caustic stone, which may be the *Sal Tartari inceratus*, which flows like Wax.

These Alkali's don't work upon Quicksilver, Gold or Silver; and if they have effect upon the other Metals, it appears to act upon their Sulphurs, so Antimony with salt of Tartar becomes a silvery Regulus, and the salt of Tartar is at top with the Sulphurs; if then *Tachenius*,
Boyle

Boyle and *Homberg* speak truth on the resuscitation of Metals, there is a secret way of making these Salts work upon the metallick fix'd Sulphur.

These fixt or volatile Salts act upon oily, balsamick, gummous, resinous Gums, and do contribute to make Tinctures, and neither *G. Hedera*, *Juniperi*, *Lacæ*, Myrrh nor others will mix with Water or Alcohol without them; they also take off the Acid from bodies, and this bond being taken off, the bodies are readily united with their Vehicles. Quicksilver made into red precipitate, is not reduc'd with oil of Tartar, but settles into a powder; however by this Salt and Fire, you regain running Mercury.

Volatile Alkali's serve several purposes, they are found in Vegetables and Animals, but whether they existed before distillation or putrefaction is a Question, unless we suppose that Salt in *Acidulae* resemble it, as *Hoffman*: Acid Vegetables afford it, animal Humours join'd with a fixt Alkali gives them out; their virtues are the same, but quicker, with fixt Salts; these fly off, which fixt ones don't, but act with the help of the first. These, if pure and apply'd with a sticking plaster over them, will give pain, inflammation, black Eschars, and in a short time will corrode to the bone, as in the pure spirit of Urine is known.

Of Acid Menstrua.

I have already given the marks of an Acid, they are generally in a liquid form, except the Crystals or Tartars of Plants; those of Vegetables are either natural or fermented; natural Acids are from the Juice of the Earth, for as Count *Marfili* tells us those which grow in the Sea

Sea are alcalious; (b) in Plants, Sorrel and some others are sour, the juice of unripe Fruits are sour: It lurks in Woods, Spices, Gums, Turpentine, &c. and tho' these Acids are not pure, yet the juice of Orange, Citron, Lemon will corrode Lead, Tin, Copper and Iron; all these Acids may be turn'd into an essential Salt, or Crystals, call'd Tartars.

Fermentation betrays an Acid in bodies, which we call *vinous* Acids, and this Acid appears in Manna, Honey, Sugar, Wine, Ales, which are liquid or solid, as Tartar sticking to the Casks; we call all Acids then produc'd by Fermentation, acetous, which are of use in Chymistry.

The Acid that exhales from Wine fermenting in Cellars will strike Persons dead, or give them Apoplexies, Madnesses, and the like, as has been known; hence we understand how Drunkenness comes; hence Tremors, &c. *Cornaro* tells us, how he us'd to be faint at the Season when the Vintage was near, which grew upon him, till he got some new Wine; *St. André, that famous Anatomist*, tells us, that a person by drinking bottled Ale fell into a Cholera and choak'd him, *Ph. Transf.* hence appears the force of Acids; Ingredients put into fermenting liquors work in a mix'd manner, to Treacle made up with Honey and a number of other medicinal drugs, ferment, and work with an united force.

Burn Green Wood, so that each end is out of the Fire, what sweats out is Acid; hence we understand why smoak of Wood is so troublesome to the eyes, and why smoak'd Fish keep long and look red: Several Woods distill'd afford this Acid,

(b) Is there then no *Alkali* to be found in Sea-Salt? Of this more elsewhere.

as Guaiacum, Juniper, Oak and others, which corrodes Metals, which preserves bodies from putrefaction, and dissolves Herbs, and makes them act: The Acid in Fossils is too strong for human bodies, it dissolves Gold, Silver, Mercury; it is poisonous and not readily to be given, unless where there is a strong Alkali in the Blood, as in Plagues, Small-Pox, &c. It is scarcely found in Fossils, unless in mineral Waters, which I have said are rather Alkaline; wherever it fixes to bodies, it soon is drawn off; we find it in Sulphur, resembling oil of vitriol. In Alum, it is drawn from the Limestone; In Vitriol or Calcanthum, it resembles spirits of Sulphur and Alum by 560° of Fire, the steams from all these will suffocate; join any of these Acids to Oil, you have Sulphur, to Limestone you have Alum, and to Iron Vitriol; hence all Acids, the same. Acid of Vitriol is the heaviest, to spirit of Nitro, as 11 to 9, to spirit of Salt, as 11 to 8, to *aqua fortis*, as 11 to 9, to spirit of Vinegar, as 11 to 9, *ac. R. Sc.* 1699, p. 47. *Memoires.* 2. 'Tis the most fix'd of any, requiring 560° to get it; 3. they attract Water gradually; 4. pour on Water it grows hot; 5. by it we get spirit of Salt, of *Sal Gem*, or of Fountains, or of Nitre, by pouring upon them; hence calcin'd Vitriol and Alum mix'd with Nitre make *aqua fortis* readily, and at bottom you have *Nitrum fixum*, as you do with Salt; 6. it dissolves Iron readily and Copper, but not Quicksilver under 560° of Heat; it dissolves Camphire into an Oil, which by Water pour'd on returns, *Boyle*.

The next acid spirit we have, is from Nitre mixt with Bole or powders of Bricks and distilling it, or by mixing Nitre with oil of Vitriol, or Calcanthum, or the Calx of Alum; we get *aqua fortis*, distill it how you will, we get the same

same Spirit; this Spirit smokes, dissolves Silver into caustick Crystals, which Oil of Vitriol does with difficulty; it dissolves Mercury, Lead, and Copper, but will not touch Gold, and scarce Tin; and when once it has fix'd upon the Metal 'tis hard to recover it from thence, as appears in Silver dissolv'd, and red Precipitate.

Sea-Salt is distill'd like Nitre, with three parts of Earth and one of Salt, or with Oil of Vitriol, or with the Calx of Alum or Vitriol, and the same Spirit is produc'd from *Sal Gem*; this Salt is the same distill it how you will, it smokes with heat, dissolves Gold, Tin, Mercury, Iron and Brass, but hardly Lead, and Silver not at all.

True Spirits of Nitre and of Salt are two fluids nearly allied, yet differ; cohobate Spirit of Nitre upon Nitre, depurated well by crystallisation, you get good Spirit of Nitre, better'd by rectification; but if the Nitre is not depurated, the Spirit from thence will not dissolve Silver, but Gold; therefore in Nitre not depurated there is Sea-Salt, and Nitre and Salt make *aqua regia*; as appears by taking Salt and pouring Spirit of Nitre upon it, and distill; and at the bottom of the Retort we get Nitre, but the liquor distill'd is *aqua regia*. *Du Hamel ac. Sc. p. 158. Boyle.* Or put Spirit of Salt upon Nitre, distill, you get *aqua regia* stronger than common Spirit of Salt, the Salt at bottom is Nitre: *Boyle, Hoffman, Bohn.* hence *aqua fortis* is made *aqua regia* with Spirits of Nitre and Salt mix'd, as Spirit of Nitre with *Sal Gem*, Salt Armoniac, or common, or Fountain Salt, or Sea-Salt.

Corollaries. From no Acids, Acids are got; from Wine toss'd by a Windmill for three Days, is got good Vinegar: *Homburg ac. R. Sc. T. 2. p. ii.* Acids that are got by the fire retain their force for many Years, Vinegar only becomes insipid;

insipid; Spirit of Salt corrodes the glass containing it; Oil of Vitriol after four Years retain'd its dissolving power; hence these Acids lose their acid nature whilst they dissolve bodies, as appears when Spirit of Nitre dissolves Quicksilver; *Homburg*: and are changed into an insipid matter; hence may be inferr'd, that Acids spring up and perish: no body gets Spirit of Nitre but from Nitre, but Nitre springs from the Alkali of Animals and the Air, or from Spirit of Nitre attracted by an Alkali, or from fat Earths; *Boyle*: and hence 'tis evident that the acid Spirit of Nitre is got of Nitre by the fire, but that natural Nitre has no such Spirit at first; hence Acids dissolving bodies are made a *Tertium Quid*; Spirit of Nitre dissolves Silver, Lead, Tin, Copper, Mercury, Nitre, Antimony, and Emeny; which differ in smell, taste, colour, and density. *Lastly*, All Acids agree in some things and differ in others.

First, They all effervesce with Alkali's, such as Chalk, Coral, testaceous Medicines, Horn, Bones, Nails, Cloth, Quick-lime, Iron, Copper, &c. and they become saline bodies, (1) and can be diluted with Water and dissolv'd in it; hence, when Water dissolves such bodies, there is a latent Acid in them; when Acids dissolve these metallic bodies, they lose their acrimony: Let half an ounce and nine grains of Spirit of Nitre dissolve Crabs-eyes, saturate the body and the liquor will be insipid, and being diluted with Water kept in a moderate heat, will appear to be nothing but Water, pour in any fixt Salt and there will follow preci-

(1) *N B.* 'Tis a grand mistake to call all these bodies saline, none being properly such but Acids mixt with alkaline Salts; whereas, when Acids dissolve Metals or Earths they are then Vitriols.

pitiation: All Acids agree in this, that when they have dissolv'd bodies they lose their further power of dissolving more; so if Spirit of Nitre has dissolv'd Mercury, call it off from that body, it will dissolve no more Mercury: They make vegetable juices red, as in Turnsole, Roses, and Violets; Vinegar recover'd from Lead is no longer Vinegar, but the Lead reviv'd is Lead again; so is Mercury from Spirit of Nitre: hence they do not change the body dissolv'd, but are alter'd themselves. (k)

These Acids differ from each other, in as much as some contain more Water than others, viz. one oz. of Vinegar contains 18 gr. of Acid; in one oz. of Spirit of Salt there are 73 gr. of Acid; one oz. of Spirit of Nitre contains two drams 23 gr. of Acid; one oz. of *aqua fortis* contains two drams 26 gr. of Acid; one oz. of Oil of Vitriol contains four drams and 65 gr. of Acid, and the whole remainder is only Water: *Homberg ac. R. Sc. F. 1. p. 52.* The Acid of Nitre dissolves Silver, not Gold; *Aqua Regia* the contrary; there the Acids are chang'd into a new body; what you get from the Vinegar after it has dissolv'd Lead, is an oleous Spirit; Spirit of Nitre is not so much chang'd whilst it dissolves Lead, then the Acid is more chang'd in one object than another; the Spirit of Vinegar is chang'd in Lead, it can never be got from Iron and Verdigrease, 'tis very strong: All Acids can be diluted with Water, they can be united with Spirits; so Al-

(k) In fact neither are chang'd, for the acid Spirit only becomes more concentred by this Solution, the Water being separated from it; for in such a Case, if you commit the body so dissolv'd to distillation, the watry part first ascends, and by a stronger fire the Acid mounts, which if you please to catch asunder, you may make the Acid, by blending them together, of the same strength it was first.

cohol

cohol with Spirit of Nitre, but the effervescence is very great; with Oils they raise flames, Oil of Vitriol and Alcohol raise a great heat, after these effervescences with Oils they leave somewhat bituminous.

Of NEUTRAL MENSTRUUM.

First, Salt Armoniac: 'Tis dissolv'd in Water and makes a brine; it attenuates and raises sweat, resists putrefaction, dissolves Gums and Resins, can be dissolv'd in spirituous *Menstrua*, dissolves the filings of Iron; good against Worms; if pour'd upon Copper and digested, then 'tis antiepileptical; its flowers drawn with Fossils make an inimitable *Menstruum* call'd the *Aquila Alba*: Sulphurs, Semimetals, and Metals thus treated become volatile; hence flowers of *Lapis Hematitidis*, hence *Veneris*, hence *Martis*, &c. are made; flowers of Antimony are so prepar'd, 'tis look'd upon as a secret to open all bodies; 'tis not distill'd without some body join'd to it; it converts *Aqua Fortis* or Spirit of Nitre into *Aqua Regia*; with fixt Alkali's 'tis turn'd into a volatile Salt; 'tis made with Sea Salt, Urine, Soot, and other things mixt, hence 'tis a semi-volatile *sal marine*, its power of acting as a *Menstruum* is as a Sea Salt.

Sea-Salt; of which I have spoke a thousand times, is got from Mines, Rivers, and the Sea; this Salt dispers'd every where is a pickle against all putrefaction; Water and moist Air dissolve it, and make a good *Menstruum* of it; it serves the same purposes as Salt Armoniac; powder it, decrepitate it, it will vanish in the fire; mix it with Metals or Semimetals, it produces wonderful changes; with Antimony it gives a brownish mass in a Crucible; repeat this operation, it becomes more metallic, do it a third time; the Salt flies

oil, and leaves a reddish, yellow mass of Antimony at bottom, hence Salt acts here as a dry *Mens-truum*; it is us'd in cementations along with brick-dust to exalt the colours of Metals, &c. 'Tis distill'd into a Spirit with brick-dust, which is a very strong *Mens-truum*: I have dissolv'd two pound of Spirit of Salt, so much pure Salt beaten small thrown in gently, I've put it into a viol and seal'd it hermetically, expos'd it to the heat of the Sun, from the 10th of May to the 10th of July; then I distill'd it till there remain'd at bottom a thick fatty liquor, in which were crystals of Salt; this Spirit I've pour'd upon fresh Salt and distill'd it thus for 25 times, drawn off the phlegm gently and redistill'd it, I have got a most acid, sharp, ponderous, oily Salt, and the Salt at bottom was very acid; I expos'd this Salt, it run in the Air, I strain'd it and join'd it along with the Oil, you get a liquor to be rang'd in the Class of *Mens-trua*, which is worth your while; Boyle tells us by a long digestion Salt will distill with a little Sand, and that the Spirit came before the phlegm; and Du Hamel says that nine parts of Sea Salt dissolv'd, strain'd, depurated, and crystalliz'd, give out one part that will not granulate, which being taken away the Salt is the purer thereby.

Salt-petre is made of an Alkaline and an Acid Salt easily convertible into an Acid, 'tis easily chang'd in the Fire; as it melts it helps to promote the flux of Metals, then it detonates with sulphureous bodies and becomes a *Sal Polychrestum*; hence it melts with Charcoal, but flows no more after it turns into an Alkali; with Bricks, Calcanthum and other powders it turns into a spirit, and proves a *Mens-truum*, and corrodes Metals, which I've already often told you. 5. Melt regulus of Antimony with Nitre, it becomes a caustick;

6. it will detonate with Salt Armoniac, and grow into a new sort of Salt which is red; 7. with *Sal marine* and spirit of Nitre or *aqua fortis*, it makes an *aqua regia*, and the Salt at bottom will be Nitre in every respect; in like manner, if you pour spirit of Salt upon spirit of Nitre, and distill, it makes an *aqua regia*, and the Nitre remains at bottom, nay spirit of Nitre and any alkaline Salt being mixt turn Nitre, Nitre is also made of Salt, a fixt Alkali and Lime, calcin'd and expos'd to run; hence you may understand how it is a *Menstruum*.

Borax from the *Indies, Persia* and *Transilvania*, dissolv'd in Water strain'd and crytalliz'd, has a bitterish and sweetish taste, and is a neutral Salt; distill'd it affords Water and Glass, which is soluble in Water, it affords no acid spirit mix'd with Sand, it promotes the Flux of Metals; hence who understands what has been said about native and other Salts, will easily understand, when they are compounded, what effects they will have; if volatile and fixt Salts are join'd together, the volatile are made stronger by the Fire, whilst fixt Salts attract the Acids and leave the Oils and Earth behind; hence they become different and of various efficacies, fixt Salts join'd to vegetable Acids make a compound Salt that's opening and diuretick, as Salt of Wormwood, and Juice of Lemons, &c. Volatile Salts join'd with Acids make another compound; the Acid join'd to the fixt Salt is penetrating and saponaceous, flows in the Fire and does great Feats, Vinegar and Salt of Tartar is *tartarus regeneratus* or *acetum radicatum* or *Sal tartari volatilis Helmontii*; these are an excellent *Menstruum*, Myrrh is best dissolv'd by such a Salt, it joins in with Alcohol, these mixt Salts make a neutral one, which is better than either Acid or Alkali, if a volatile Alkali be join'd

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with

with Vinegar, it has a peculiar virtue of dissolving, which you wou'd seek for in vain elsewhere, which is good in the eyes or ears, and any matter con- creted, and Vinegar join'd with Urine is an ex- cellent discutient, so volatile or fixt Salts join'd with acid Spirits or with Acids of Fossils pro- duce other Salts, to Alum dissolv'd in Water, and warm'd, pour in warm oil of Tartar till 'tis saturated; the Calx falls down and the Water at top is a *tartarus vitriolatus*; so if to any Vitriol, we pour on a fixt Alkali, as warm oil of Tartar, you precipitate the Metal, and the liquor is a *tartarus vitriolatus*, only Copper in some part re- mains in the liquor and gives a blue, so in all mi- neral Waters Alkali's precipitate the Metal and leave the liquor a *tartarus vitriolatus*; when the Acids are join'd to volatile Salts, they make a Salt Armoniac, which may be call'd a *tartarus vi- triolatus*, these Salts have a power of attenuating, opening and stimulating, when Salt Armoniac is join'd to any Vitriol, it makes a *tartarus vitriola- tus* semi-volatile; part of the Vitriol falls, hence may you judge of the nature of these mixt Salts.

We will now consider the mixture of fixt Al- cali's with Acids, produc'd with the Fire, when an Alkali and a distill'd Acid are join'd, they resemble Nitre, if the Acid of Alum or Brim- stone or Vitriol are join'd with it they make a *tartarus vitriolatus*; if a volatile Alkali be join'd to a Spirit of Salt or *Sal Gem.* it makes a Salt Ar- moniac, if it is join'd with Spirit of Nitre or *Aqua Fortis*, 'tis Nitre; hence you see the varie- ties of mixtures and what differences they make, but without an accurate knowledge in these things, one can't understand the doctrine of *Menstrua*, if a pure Alkali be put to Salt Water, the Brine is muddy, an Earth falls and then the Salt becomes
pure

pure by crySTALLISATION, a fixt Alkali added to a Lixivium of Nitre, Earth precipitates and the Nitre is pure; the fixt Salt Armoniac put to Brine, the Salt at bottom is fixt; the volatile Alkali being pour'd to Brine disturbs it and then flies off, if the same be mix'd with Nitre dissolv'd, it flies off and depurates the Nitre, if it be mix'd with Salt Armoniac dissolv'd, it also depurates it, but does not disturb the liquor; Vegetable Acids mixt with Sea Salt, Salt Armoniac or Nitre, change only a little, neither if they are distill'd; Vitriol and Alum calcin'd to a dryness, they retain a fixt and strong Acid, and if calcin'd Vitriol be put to Salt and distill'd, you get a pure Spirit of Salt, and at bottom there's a *Sal mirabile Glauberi*; if Quicksilver be beaten with calcin'd Vitriol, and mix'd with decrepitated Salt, distill you get a *Mercurius sublimatus*, which is only a vitriolick Salt; *Aqua Fortis* may be got from Alum and calcin'd Vitriol mix'd with Nitre; if these two be mix'd with Salt, they make a Spirit of Salt, if with Nitre and Salt an *Aqua Regia*; if Nitre and Colcothar be fus'd together, it makes a vitriolated Nitre: Sea Salt calcin'd with Colcothar makes a *Sal mirabile Glauberi*; hence Salts mix'd with Salts make always new Salts and new appearances arise, which both please and profit.

Menstrua do also produce new *Menstrua* when join'd together, moreover the reduction of each *Menstruum* to the utmost purity, and dividing them into their minute atoms, are what deserve the principal care of the Chymist; for example, I want a pure vegetable Acid, take Verdigrease, pour on the strongest Spirit of Vinegar twenty times distill'd, digest 'em, strain 'em, inspissate 'em with a gentle Fire till a crust appears at top, set 'em by to crySTALLISE, pour off the li-

quor and take out the Crystals, inspissate this liquor again, and take all the Crystals you can find, this is a way of getting the pure Crystals, this affair succeeds only in Copper; this Vinegar may be made with any fermented liquor; *Zwelfer* thought by this he had got an Alcahest, but there is no end of new *Menstrua*, the Spirit of Bread would hardly be believ'd to dissolve what it does, *Tartarus regeneratus* will mix with pure Alcohol, which then is an alkaline and sulphureous *Mensruum*, it dissolves distill'd Oils, Spirit of Nitre saturated with Spirit of Salt Armoniac, we get a volatile Salt of Nitre; which may be a good *Mensruum*, thus have Chymists spent their time in finding out these inventions: And I recommend the same to your further labour.

'Tis my part to descend to some corollaries:
 1. all these *Menstrua* do require some Fire to assist their operation; 2. they must be made fluid; 3. some act by attraction, and others have a power of acting within themselves, so Spirit of Nitre smokes, Spirit of Salt Armoniac is always in motion, which may be communicated from the Air, by this motion solutions often happen, which would not otherwise have happen'd; for example, Chalk is not chang'd in the Fire, in Storms, in the Air, in Water, in a Lixivium of Salt of Tartar, but in Vinegar, and is dissolv'd there; 4. that which will corrode our bodies, will not corrode Sulphur or Wax, as appears in Oil of Vitriol; 5. *Menstrua* can't dissolve a great many bodies, unless they have first been dissolv'd in another *Mensruum*; so Sulphurs is not dissolv'd in Spirit of Wine without Salt of Tartar; so Silver dissolv'd in Spirit of Nitre, then digested in a pure Alkali, then sublim'd with Salt Armoniac, you get a running Quicksilver, *Boyle, Homberg. Tachenius,*

chenius, which I have not yet experienc'd; 6. some bodies dissolve others, which you cou'd not have thought of; so Turpentine penetrates the body and makes the Urine smell like Violets, it also dissolves Resin, Gum Resins, Copal, &c. and the Yolk of an Egg dissolves it as well as other Gums, Oils and Resins, Balsams, Manna, Honey, Sugar, &c. *Helmont* praises the white of an Egg distill'd in preparing his medicated Mercury, and a white of an Egg boil'd to a hardness, and put into a Cellar, affords a liquor that dissolves Myrrh; 7. 'tis dangerous to pronounce *a priori*, what is a *Menstruum*, but experience must guide us; so if Silver be boil'd with Cream of Tartar, it becomes white, but with common Salt not at all; 8. nor must a Chymist determine by any reasons what has dissolv'd a body, being so many reasons for its dissolution, which are hard to hit upon; 9. all corrosion is relative between the matter corroding and the particular thing to be corroded, for example, *Aqua Fortis* corrodes Animals, Vegetables and Fossils, we can't therefore conclude that it will dissolve Wax; 10. we cannot say that because this *Menstruum* is mild in respect of our bodies, it will be so in respect of others, so Oil is not hurtful to us, but it will dissolve Sulphur and Wax, Wax takes out the colour from Coral, which the Fire will not; hitherto nothing has been found to cure the Stone or a Cancer, however we must not despair, for some time or other these remedies may be found out; Spirit of Rye-Bread has the power of dissolving some Stones, but does not hurt the human body, the Water and a White of an Egg boil'd dissolves many things, but hurts not the eye; 11. *Menstrua* do change their objects and are chang'd themselves, Water, Alcohol and Mercury are little chang'd, tho' somewhat; 12. 'tis an error to think that the

more pure *Mensirua* are made, the more they will corrode, Lead is better dissolv'd in Spirit of Nitre diluted, Iron in Oil of Vitriol diluted, Alcohol coagulates the blood, but dilute, it dissolves, on the other hand they are sometimes requir'd very pure, only Alcohol will dissolve distill'd Oils and Amber; 13. virtues are produc'd anew, by these mixtures; a person may take some grains of Mercury, he may also take some grains of Spirit of Salt, but sublimate which is made from these two is dangerous, so you may give 30 grains of crude Antimony to a Child; you may also give the same of Nitre, but when these two are mixt upon the Fire and detonated, they are made into a *Crocus Metallorum*, six grains of which wou'd kill a child; hence precipitancy is to be avoided by Physicians and Chymists, Medicines casually hit upon must be tried in very small doses; try and then trust.

Of the universal Menstruum or Alcahest.

Whoever considers what is already said, will find that attraction and repulsion, except some few mechanical Affections are the causes of solutions, and every action depends upon a relation between these two, and hitherto no one body has been found capable of dissolving every body, and it appears to be impossible, however *Helmont* said *Paracelsus* possess'd such a secret, which he call'd Alcahest, which wou'd be a great blessing to mankind and a greater treasure than the Philosopher's Stone; so thought Mr. *Boyle*, who with all his diligence cou'd neither find nor believe such a thing; I shall set down the opinion of authors on this head, which however they extracted from *Helmont*, for from *Paracelsus* we meet with no such thing, and as I have
not

not the secret myself, I will give you what the authors say of this thing.

1st, *Paracelsus* calls it *Alcahest*, he tells us 'tis necessary to know to prepare this *Alcahest* for the curing many diseases of the liver, he mentions this word but once in his own works, the rest is all *Helmont's*.

2^{dly}, As for the Etymology, *Paracelsus* us'd to invert words, he call'd *Tartarus*, *Satrator*; he call'd *Crocus*, *Aroph*; and some say *Alcahest* is *Alcali est*; some think 'tis from *Saltzgeist*, that is *Sal Marine* coagulated, some think 'tis from *Algeist* or a pure Spirit.

3^{dly}, Thus far for conjecture: Let us now proceed to synonymous terms; first, *Helmont* calls it Water, which he would not publish, but which distill'd all Vegetables into a juice and threw the sediment down to the bottom; he says, he digested it with Charcoal in an hermetically seal'd Glass; he calls it also a thick Water like the Water in the *Maccabees*, which was a continual Fire; he calls it a dissolving Water, and he also calls it *Ignis-Aqua*, and says he had receiv'd a Jug, in which was the *Ignis-Aqua*; he calls it a Latex elsewhere reduc'd to the minutest atoms, and often calls it liquor, and says it dissolves all bodies into Water, he calls it *Ignis Gehennæ*, all which signify that it was a liquid; he says he dissolves Sand and makes a Salt of it; if this be *Paracelsus's* *Ignis Gehennæ*, we may know what it is; he afterwards says that it is a Salt, that it has attain'd the utmost subtilty, he calls it *Ens primum* of Salts, he calls it a circulated Salt in several places, if then *Helmont* was sincere, we may find out this *Menstruum*.

4^{tly}, But before we endeavour at this we will consider its origin; he affirms that Earth will be reduc'd into Water by art, that this can't be done without

without this Latex, and this is found out by Chymistry, by a long and tedious preparation, and that God Almighty is the only dispenser of this Secret, that neither reading nor the thought of Man could have invented it; there is, he says, but one dissolving Liquor that can reduce all things to their first matter, &c.

5thly, Let us now see the virtues of this miraculous Secret, it has a power of dissolving all things in nature, you may read him, p. 43. parag. 11.

6thly, Let us consider the manner how it works; he says that its virtue is excited by fire; that it dissolv'd Charcoal in three days by a gentle heat; that it chang'd every Oil and Spirit of Nitre into another shape; that it chang'd Cedar cut into chips into a milky Liquor in a week; that it pulverises Mercury in a quarter of an hour, whose weight was not diminish'd: He says, sometimes cohobation is necessary to make it work, particularly on Gold; that at one distillation it dissolves Stones; that by a second degree of fire 'tis distill'd, but does not ascend with a balneum.

7thly, Let us consider its effects; namely, it changes every thing into one mass, and that into a liquid: Quicksilver by it becomes fixt, other bodies become a Salt; Charcoal into two diaphanous Liquors; Cedar milky, and then divides into two Oils, which Oil turns into a Salt miscible with Water; a Stone taken out from the bottom of the *Schelde* near *Antwerp*, it turn'd in two hours by distillation into a Salt that melted; that Mercury refuses to be turn'd into a Salt; and these Salts after solution retain'd the seminal virtue of the simple body; by this dissolvent all things return'd to their *ens primum*, and enjoy their proper virtues: He says it dissolves all solid things into their first matter; hence it mixes with
all

all the humours of our body, passes through all its vessels, and exercises its power where-ever it passes; it leaves this matter so dissolv'd, and is separated from it, but neither encreases nor diminishes the substance; hence it acts not by concreting with the body chang'd, nor melts it as Water does Snow; hence this *Menstruum* does not act by attraction or repulsion, but only by a certain mechanical power, contrary to all other things save fire; and, 2^{dly}, it preserves its own virtue, and destroys the poison of others: He says, that every body is chang'd into an actual Salt, which is equal in weight to the body from whence it is made, and that Salt often cohobated with this circulated Salt, is chang'd into Liquor; so Sand is chang'd into Liquor: He says he knows a Water that changes all vegetables into juices that have no dregs, which being distill'd with Alkali's becomes Water; that the Charcoal it dissolves turns into Water like Rain, and then it makes all things so volatile that they fly off and leave the Alcahest at bottom.

8^{thly}, What is wonderful is, that it changes all bodies, itself being not chang'd, and in this it resembles fire, which acts without being re-acted upon; after corrosion of Charcoal, it is at bottom as before; it knows not how to dye, 'tis single and joins in with no body. It agrees with *Helmont's* description of it, viz. That Salt of bodies being often cohobated with *Paracelsus's Sal Circulatum*, turns into Water, and this Alcahest is said to have the virtues of the *Ens Salium*: He calls it the most fortunate Salt, when pure, because it passes through all, being unchang'd itself; it acts wonderfully on Oil and Spirit of Wine; it reduces bodies to its own Liquor, and with it the *Ludus* may be prepar'd.

But

But *Paracelsus* has a greater dissolvent than the Salt spoke of, and calls it *The Mother of the Salt of Mercury*: He acknowledges Fire and celestial Life, and a celestial quintessence in Quicksilver; when these two are united, we can have a *Mercurial Water*. — *V. Archidox* X. c. 6. he says, as Gold is not chang'd by being corroded, but may be reviv'd, so nor Mercury which is Water, with this Salt which is Water: The internal Mercury of Metals, he says, free from all Sulphur, is indissolvably connected, and obstinately refuses all division, &c. — I have found Mercury adequate to Water, for it contains no Earth, but is the Son of Water: — The fire does not change it, whether it flies off or remains on the fire: — It is homogeneal in its parts: — It is indestructible in its elements: — It is like the *Ens Metallicum* of Metals, — simple, — not a constituent: — It is only chang'd by its like. — Behold, my Hearers, the history of *Paracelsus* and *Helmont's* Alcahest; you see nothing from Urine can be this *Menstruum*, nor any thing of Tartar, nor Phosphorus, nor *Glauber's* fixt Salt of Nitre, nor *Zwelfer's* Spirit of Vinegar, nor *Rolfincius's* Salt of Tartar and Vinegar of Antimony, which is only a *Tartarus Vitriolatus*, nor *Tartarus Tartarisatus* of Vinegar and *Sal Tartar*; and from Salt of Tartar with four Whey we only get a *Tartarus Tartarisatus*. I am of the opinion of *Faber* in the *Eph. Germ. Anno. 8.* where he says, that Alcahest is a mercurial Spirit; that these two are made one; that it is indestructible tho' it destroys all; 'tis the true Mercury of the Philosophers; 'tis a milky buttery Liquor, penetrating and dissolving all; 'tis simple and compound, the simple is made of a metallick Acid, the compound of this metallick Acid and the Salt of Animals and Vegetables; the Alcahest or Mercury of the Philosophers;
'tis

'tis mere Fire, unchangeable itself and destroys all other things: *Becher* thinks the same, he says in Sea-Salt is contain'd the Alcahest, which however differs from the Mercury of the Philosophers; he thinks that Mercury is a sulphureous Metal, and that its fluidity depends upon its arsenical Sulphur; this is a subtle speculation, and I wish he had demonstrated it: He tells us, that pure Silver dissolv'd in Spirit of Nitre and precipitated by Spirit of Salt becomes volatile, and dispos'd to part with its Mercury, therefore Sea Salt can convert the purest Metals into Mercury; if you ask my opinion what it is, I say that *Helmont* having complain'd that he had lost the bottle, he could not therefore try many experiments upon it; and *Paracelsus* does not boast of such great things from his dissolvent, for the rest, if you treat Mercury and Sea-Salt chymically, you will not lose your labour, but for the Alcahest, I know not what to say of it. (l)

Of the Chymical Vessels and Instruments.

By Vessels they understand those hollow bodies that contain things to be chymically treated, and by instruments I understand (m) those things which apply the materials to these Vessels; these chymical Vessels must be able to sustain the Fire and not be chang'd, we call these containing Vessels, those which receive the liquors we call recipients.

The matter of these Vessels in either of Wood, which contains Salts, to be shut up, or of Glass

(l) Why are such devious pains taken to prove the Philosophers old Maxim, viz. *De non apparentibus & non existentibus eadem est ratio.*

(m) See *Comenius's Janua Linguarum.* Cap. 26. p. 814.

which

which are not apt to spoil any thing put into them, and are to be made use of, when the Fire is not to be very strong, the white Glass is apt to crack, but the green will bear 600° of heat; I wish *Helmont* had told us his secret for cooling of Glass; the third is of Metal, and before all, Iron is the most preferable, the next are earthen Ware from *Hess* and elsewhere, they bear a strong Fire, yet they are apt to let spirits thro' their pores; those spiral Tubes for distilling of Vinegars are best made of Tin, the heads are best made of Glass, these earthen Vessels must be coated where a great Fire is requir'd, these earthen Vessels are often made in the *Indies*, and purcelane Vessels are best to hold acid Spirits; as for the figure of Vessels, those glass Vessels which are for holding volatile liquors, should have long cylindrical Necks with glass stoppers, very close and well fitted. Those Vessels, which are for dropping liquors into, should be Jug fashion, with a cylindrical neck, with a broad margin in one place a little hollow, a Stopper of Cork or Wax if they be acid Spirits; see the Figure; we shall now treat of Vessels that are to contain, and those that are to receive bodies; 1. Crucibles are of a conical Figure, these Vessels if they are low and broad, the volatile matter flies off the easier, when a volatile matter is to be separated from a fixt one; the Vessels are of three sorts, Cylindrical, Conical, with the base upwards or the apex upwards, the cylindrical ones differ only as to height, they should be high to separate the less volatile from the fixt; and when Vessels from a narrow bottom become more expanded, as in Hemispheres, then every point of the base sustains the incumbent column of liquor, whose altitude is taken from that point, to the point of the surface, which is a perpendicular from that point to the
Horizon

Horizon (*n*). Hence 'tis plain the columns are shorter the nearer they are to the surface; hence a broad figure helps the elevation, and makes it more expedite; hence we have the idea of a retort, 'tis a hollow sphere ending in a cylindrical neck, whose upper horizontal line is a tangent to that sphere at top; (*o*) the lower line of its neck is a diameter of the same sphere parallel to that tangent, wherefore such a Vessel easily passes from the retort into this cylindrical opening, and so into the recipient, such a Vessel is fit for parting very fixt from the most fixt, as acid Spirits; the next of these retorts are bent, the liquors may drop down, but in such tedious distillations where bodies resisted the ascent, I made cylindrical Vessels, as in the table; and instead of retorts for distilling Oil of Vitriol, I have made use of Jugs as the most secure, as you may see in the figure; the rule then is, the more difficult things are to be distill'd, the more convenient the figure shou'd be, of the receiving Vessels; such are the *Clavæ* of the *Germans* and *Dutch* call'd cucurbits, and formerly urinals, in these liquors are let back again; then the length of these Vessels is to be consider'd, the higher they are, the more difficult will the sublimation be; the speculation of these three things has given rise to a new invention of making Alcohol at an easy expence, *viz.* a Cone is made of Tin, its base six inches in diameter, its vertex of one inch diameter, its height four feet, with a tube descending into another cylindrical spiral tube, call'd

(*n*) That is, in *English*, the Surface is not so deep as the Bottom, or is higher than the Bottom.

(*o*) This is *Notum per ignotius*; for every body knows what a Retort is, but few his Explication.

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a serpent, this is call'd a matrafs, and which is a very convenient instrument for distillation and digestion, but are apt to crack: the figure of recipients is either Spheroidal or Spherical, they ought to be large and well cemented; see the table. Retorts and recipients would serve for all uses, unless more Volatiles are to be separated from less Volatiles; and here alembicks are requir'd, sometimes we must cohobate, that is redistill, for this purpose Chymists invented a *Pellican*, but as such Vessels are not easy to be had, two glass Viols will serve the turn well united, but they are not to be join'd till the body is warm'd, least the included Air by its expression shou'd crack the Glasses.

Of LUTES.

Are Glues for hindring the Air to enter or Liquors to pass out; *A Lute for watry liquors*, is, powder Linseeds, out of which the Oil has been express'd, and mix it with the White of an Egg, this serves for closing the Vessels and for cracks, and a Paste made of this and Water, is a Lute for Brandy Spirits and volatile ones.

But this does not suffice for acid Spirits, then a bladder suffer'd to lie in Water till it grows viscous in a good Lute, but for the acid Spirit of Fossils, the Lute call'd *Sapientia* is fittest, and 'tis made of Colcothar, boil'd in Water till it loses all its Salts, mixt with equal parts of Quicklime and the White of an Egg; when 'tis dry it grows as hard as a Stone, or potters Earth and Sand finely powder'd and made into a mass with Water till it does not stick any longer to your fingers, to which add common Lime $\frac{1}{4}$, and make a paste.

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The coating for Vessels is covering them all over so as that the coating is between the Fire and the Vessel, this is necessary for glass Vessels, the best of which is made as before with Potter's Clay, Sand and Lime Plaister: And this is call'd Lorication.

Of FURNACES.

I shall now descend to furnaces, on which affair you may consult *Agricola* and *Glauber*; a Furnace is a machine to contain the Vessels and to apply Fire to them; hence in a Furnace the requisites are a Fire, and proper *Pabulum* along with a Chimney, an Air-place, and a Door, then care must be taken that the Fire be directed to the body to be wrought upon; 3. to keep the Fire equable, the least expensive are the best, the first condition is that the Fire being kindled may fall directly upon the body to be chang'd; which is obtain'd by the figure of it. 2. That the Fire be made of the least consumable Materials; 3. That the Fire be continu'd with an equal standard, for were the degree not to be determin'd we should have confusion: Hence first we must think of the quantity of Fire; next of the *Pabulum*; 3. of the degree mensurable by a Thermometer; 4. of the easy access of the Air and all its properties, as Gravity, Humidity, Heat, &c. 5. of the manner of its exit; hence broad Chimneys are the worst; now I shall describe to you the different Furnaces; the first is call'd the students Furnace, the second is for distilling from sand, the third is the *Balneum Mariæ*, the fourth is for an open Fire, the fifth is for distilling of

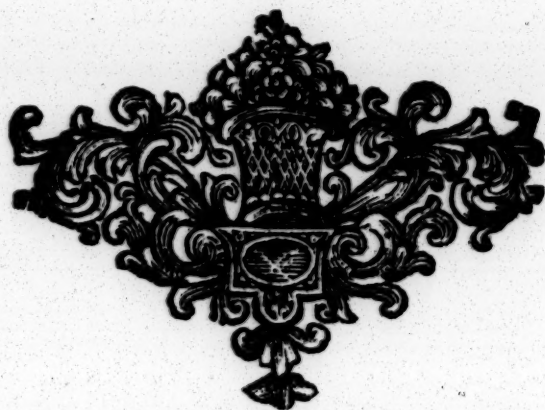
(p) See *Comenius*, C. 86. Par. 816.

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Acids, and the last for Metals: As for the Furnace for the Alembic and the Serpent and Refrigeratory, 'tis known by every body: And thus I have put an end to the first part of our Chymical Institutions. (q)

(q) *N. B.* We have forbore to follow the Professor in his descriptions of the Furnaces, because they are sufficiently illustrated amongst the Figures and the Explications of them; and this we do to avoid nauseous repetitions so disagreeable to Men of Sense: Descriptions themselves are lame, seeing informs best. Among his Furnaces he says nothing of the *Atbanor*, for which see *Le Fevre* and others; this is an *Ara-bick* or *Hebrew* word, from *אֶתְנֶן*, *Fornax*.

The END of the first Part.



A N
ABRIDGMENT
O F
T O M E II.



P R E F A C E.



NOTHING offends discreet Persons more than to find in Chymical Authors Processes without Order or Design; the Professors themselves have hitherto shew'd nothing but Processes promiscuously, as the Professor thought fit; but as soon as Pupils above thirty Years ago were willing I should teach them Chymistry, I began to think seriously whether they could not be put into a better Order, so that, according to Hippocrates, nothing might be done rashly, nothing be omitted.

Therefore that nothing might be done in vain, I make one Operation serve for many; I shew how to prepare Bawm Water, the same Process will serve for Marjoram, Rosemary and Rue: I want, for example, a Citron-water distill'd from Wine, the same Process will serve all other aro-

matick Spirits, and so I avoid a nauseous Repetition.

And I have always shew'd whatever ought to precede, before I proceed to what ought to follow ; and thus I observe the Order of the Mathematicians, and take notice of every thing that is singular, and thus I improve this Art so useful to learn the Powers of Medicines. In this I have not always an Eye to Physick, but also to Natural Philosophy, for which it is very useful ; and as the Processes are employ'd on Vegetables, Animals and Fossils, I shall first treat of Vegetables, and I shall take all for granted which I've spoke of Vegetables in the first Part.

*By Operations I mean the Changes that are introduc'd in Bodies, to which four Conditions are requir'd ; first, That it be very easy ; secondly, That it be simple, and done with the least Trouble ; thirdly, The first Operation must not introduce any great Change on the Body ; fourthly, It only must be a Separation, but no Change of the Parts must be introduc'd : From this we shall have a fourfold Advantage ; first, We shall know what Parts are really in Bodies, naturally ; for when we torture Bodies, we must not conceive those Parts * pre-existent that appear ; secondly, The Artist will be sure that what remains behind is not changed ; thirdly, It will be in his Power to know*

* Then we create, or at least alter and don't separate Parts.

what did remain behind, and to examine it ; fourthly and lastly, He will exactly know what has been us'd in this Experiment, and what Force has been us'd : I could wish this Work had been done to my Hand.

There are some Conditions requir'd to perform this first Operation ; first, That what is separated be most simple ; secondly, That it be such a Body from whence others are made ; thirdly, That it be easily separable, and thus the natural Order of Things will be observ'd.

The Instrument also, by which this is done, requires some Conditions ; first, That it be very simple, lest it spoil the Material ; secondly, That being applied, it may serve to be employ'd in all the Operations that are to follow ; thirdly, That it don't change the Body further than this first Operation ; fourthly, That it don't change the Order of its Particles, otherwise other Parts would be mix'd. When these Conditions are observ'd, the Artist will know what concurs to constitute the Nature of the Body to be examin'd ; to all this a gentle Fire contributes.

Vegetables are compounded of Fluids and Solids ; there are in Vegetables absorbing Vessels, which are particularly in the Root. These admit of Air and Fluids ; as they admit of Air, they serve as a Larynx ; these are evident in the Stalks of Dandelion.

lion. Some other Vessels serve for Motion, and they propel the Fluids receiv'd : There are also Vessels which change the Fluids into new Forms, and give 'em the Nature of the Plant. Fourthly, There are peculiar Ducts, that receive peculiar Juices ; thus it is in Aloes ; thus in Celandine, where a golden colour'd Juice is separated ; thus in Tithimal, whose Juice is milky. Fifthly, There are peculiar Receptacles, where the Juices remain long at rest, and these contain the Oil. Sixthly, There are secretory Canals, from whence watry Gums and such Things issue. The Liquors in these Vessels differ infinitely ; in the Acetabula of the Leaves of the Flowers of Aloes I find a Liquor like Honey, whereas elsewhere 'tis altogether bitter ; hence how great a Difference must there be in these Juices, when we treat 'em chymically ? next, as the Juices are so various, what they afford chymically must also be such ; for example, the Pulp of Cassia affords one Liquor, the Bark another ; the Pith of a Sugar-cane affords Sugar, the rest acid, &c. Thirdly, We must observe the different Colours ; thus Poppy, or Esula, being wounded, a Milk issues forth, but Beet gives a red one. Fourthly, You must observe the Smells which are peculiar in each Liquor ; in Jessamin the Flowers only are fragrant, &c. Fifthly, We must observe the various Tastes, and as each Plant has its peculiar
Smell,

*Smell, so each has its peculiar Taste. Sixthly, We must observe Seasons which give great variety to Plants. Seventhly, We must observe that all Plants have some Salts in them, and the Water being evaporated in Summer, they then abound more in Salt, Spirit and Oil. Eighthly, Artists very rarely get the pure parts from the Plant, which Nature had bestow'd on it, but they change it by their Operations sometimes into very contrary Parts. So Helmont acknowledges. However, O ye best of Hearers, 'tis certain that Chymistry produces somewhat new, which was not in * nature, and those products must have new Virtues.*

Behold, most noble Hearers, by virtue of my Office I have forewarn'd you of several things, pardon me if I have been tedious, or shall be so by my Harangues, every thing in nature being well done, without Mistakes, will be full of somewhat new; he who errs, the further he proceeds, the more harm he does. I will first shew you what is to be done with the Body, so as not to change it: I will then exactly describe to you the Operation itself. Thirdly, I will propose the effects this Operation has had upon the Body. Fourthly, I will expose these Bodies, thus treated, to your view. Fifthly, I will shew you the Instruments by which 'tis done. Sixthly, I will subjoin some corollaries that follow. Seventhly, I will shew you their

* A grand Mistake.

Virtues, in which affair I will be ingenuous without boasting; I will also point out to you the Indolence of some, and the Falsity of others: In which affair I will be of use, having by the long experience of the third part of an Age learnt the truth of things, I will not deceive any.

I will begin with recent Plants gather'd in the Summer, I will try all the Operations upon this Plant that I can; for example, I will first get the Water from Rosemary, then the Salts, Oils, and what else it will afford, whereas were the Water got from one, Salt from another, and Oil from a third, we should never understand the Analysis nor the true Operation of a Plant: These things were previously necessary to be known before we begun the Operations, now let us proceed prosperously.



THE



THE
FIRST PART
OF THE
Chymical Operations
ON
VEGETABLES.

PROCESS I.

*The distill'd water of Rosemary exhaling in the form
of vapour, by a heat equal to that in summer.*

The PREPARATION.



TAKE full grown fresh Rosemary, with the morning dew on it, whole, not cut or bruised; put it upon the round plate into the furnace. *Plate 17. Fig. 2.* piled up three inches high, without squeezing it, then cover it with a tin alembick, and fit a recipient to the beak; make a charcoal fire of 85° (measured by *Fahrenheit's* thermometer) keep up this heat

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heat, till you have got enough of the water; keep the liquor in a glass bottle, close shut, for some days, in a cool place, unmov'd, 'tis odoriferous.

The nature and use of this water.

In this liquor are contain'd, 1. the dew, moisten'd with exhaling parts of the plant; 2. the watry juice of the plant, as appears by leaving the vessel, that holds it, open, for the evaporation of the odoriferous parts; 3. the seeds, or the mother, which mucilage grew more and more, after having kept the water a year, and made the water muddy. In this water then there is water and the *Spiritus Rector*, which gives the peculiar smell and taste to each plant, and this is the part that exhales, leaving the water behind.

The virtue resides in this volatile part, which, by its moveable acrimony, excites the spirits, and moves the nerves; hence do they relieve faintings by their fragrancy, so long as they retain it, which soon flies off.

It is to be observ'd, that this *Spiritus Rector* differing in each plant, we must not wonder if we meet with each aromattick plant or any other differing from another in virtue, altho' of the same class; so Lavender and Bawn are highly enlivening and throw off any torpor of the nerves; so *Indian Hyacinth*, tho' fragrant, excites spasms in hysteric and hypochondriack persons, and Rue cures these spasms, let therefore chymists be wary in pronouncing dogmatically on these waters; Rue then and Bawn are known to revive the spirits.

Hence is known what it is that exhales from vegetables in summer, and the juice that drops upon cutting trees is of this sort: *Hales*. Hence the advantage by living in proper places, as well

as the disadvantage; thus in *America* were people rendered sickly; thus living under the shade of the Walnut or Yew-tree renders persons sleepy.

A list of such follows: Southernwood, Mother-wort, Garlick, Dill, Angelica, Aniseeds, Orange, Calamint, Cardamoms, Catmint, Cloves, Gilliflowers, Aromaticks, Cassia, Sallary, Onions, Chervil, Camomil, Cinnamon, Citron, Scurvy-grafs, Coriander, Saffron, Cummin, Dittander, Fennil, Galingal, Clary, Hyssop, Jasamin, Lavender, Bay, Lovage, Lilly of the Valley and the white, Lemon, Mace, and all other bitter Aromatick and Fœtid plants or trees; all these contain a volatile and aromatick matter, which is got by this first preparation; and sometimes there is a peculiar virtue in the root, as Cinnamon affords Camphire, sometimes in the woods as in Rhodium, sometimes in the bark as in Cinnamon, sometimes in the catkins as Walnuts, often in the flowers, leaves and seeds; therefore, O my hearers, how many things do you learn from this first preparation?

PROCESS II.

An Infusion and a Decoction from the remainder of the first Process:

We will now examine what the fire and water does by the heat from 45° to 85° , and so gently to 212° , or till the ebullition.

The PREPARATION.

First, Take the Rosemary that remain'd from the last operation, 'tis now dry and without smell, and crumbles with your fingers and has another taste; let it dry well in the open air. *Secondly*,
Pour

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Pour pure rain water upon it warm'd from 85° , even to 211° ; let them infuse and continue in this heat, the vessel being shut for half an hour or more, pour out this liquor, 'tis an infusion of Rosemary, without much smell and robb'd of the taste; pour the water of the first process on to this infusion, and you have the virtue of the plant, and perhaps (a) this is the best way of getting the virtue, unless you prefer the express'd juices. *Thirdly*, Or boil the plant, with the plant left after the first process, and then 'tis call'd a decoction or apozem; which if you put into an alembick, fit to it a recipient; the water distills and leaves a decoction behind, or if you boil the whole plant in *Papin's* digester, it has the whole virtue of the plant, but differs in some small matter in its effects. *Fourthly*, To the remainder, after the first decoction, put on fresh boiling water, and boil, take off the scum, 'tis oily and burns, pour on and thus pour off water in this manner for twenty times together, till the water affords neither taste, colour nor smell, avoiding smoak, &c. then the leaves are as big as at first, become brown and sink to the bottom. *Fifthly*, When the plant is resinous as in Guaiacum, we must either macerate or put in Salt of Tartar, or this oleous part will not be communicated. *Sixthly*, Such resinous vegetables, when fresh, communicate their oil to water, but not when dry; so with Guaiacum they cure the pox in *America*.

As therefore boiling water, where a heat of 212 degrees is requir'd, makes somewhat volatile fly off, such plants are not fit for decoction; hence those that are more fixt, such as acids, astringents, viscous aromatics, demulcents, emollients, coolers, nutrients, saponaceous, and viscous ones,

(a) Pray wou'd not infusion upon the fresh plant answer our ends with less labour?

that

that are not resins, are fit for decoction, such as Wormwood, Acacia, Sorrel, Water-creffes, and the like are fit for this purpose; hence also the juices of fruits expressed but not fermented; mean while I don't say that the *Spiritus Rector* will be communicated, or however it may not affect our senses as in the roots of black *Hellebor*, *Cicuta Aquatica*, and *Solanum Maniacum*.

The nature, virtues, and use of these decoctions and infusions.

First, Vegetables being so prepar'd, will pass all the vessels and mix with the humors. *Secondly*, And act with their whole force, by the impulse of the Blood. *Thirdly*, They have not the same efficacy with the water of the first process, yet this loss is repair'd by the fire; particularly if the water be pour'd upon the decoction. *Fourthly*, The virtue also depends upon the warm water; hence they who drink Tea hot, may as well impute the damages they receive, to the hot water as to the Tea. *Fifthly*, Hence we see the manner of preparing infusions and decoctions, then we find the force of boiling water upon the solids, nothing of which is destroy'd thereby, tho' they were the tenderest flowers, as I've found by the microscope. Hearken, ye physicians, and see how boiling water does not dissolve our vessels, they are rather broke by the impulse, than with the heat or moisture, therefore our vessels are terrestrial parts join'd with the glue. (b) *Sixthly*, Dry these leaves, they grow less, moisten them with warm water, they grow large again. *Seventhly*, Some plants lose their force by

(b) Pray what becomes of our vessels when we are scalded by water? does it not flea us both in the mouth, stomach, and the hardest parts of our skin, and raise inflammations?

boiling,

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boiling, as Arum and Alarum, the latter of which being infus'd, is vomitive, but boil'd, is diuretick.

P R O C E S S I I I.

The extract call'd the Sapa, Defrutum, Rob or Jelly, made from what remains of the second Process.

The P R E P A R A T I O N.

Now we consider what is produc'd upon calling off the water. *First*, Let the infusion or decoction settle, then strain it; some make use of the white of an egg, which they boil along with this decoction, and so let it settle. *Secondly*, Exhale the liquor so depurated, till it grows of the consistence of honey; it must not be strongly boil'd nor burnt. Thus is prepar'd Liquorish juice, and the rob of berries; we may call this must, and this being boil'd to half, is call'd Sapa; to one third only, Defrutum, *a defervendo*; when 'tis boil'd so as a drop will congeal, 'tis call'd Jelly; and if to the thickness resembling honey, but thinner, a Syrup; if yet thicker, a (c) Rob or Robob; but extract is a general name for all.

The nature, virtues and use of all these.

The dissolution therefore in warm water is a decoction. These may be kept long; they preserve their taste, but lose their smell; they have the virtue of the whole plant, as to its first parts; if the plants from whence they are made are putrify'd, they communicate no virtue. These things are fit to carry to sea, such as marmalade of Barberries, Currants, &c. However, where there is

(c) From ב״ב, *succus condensatus*.

any salt in 'em, they will melt in the fire; as the marmalade of Lemons, therefore they must be kept close cover'd.

PROCESS IV.

The calcination of what remains of the vegetable after the second Process.

Now let us examine what the open fire will do to these plants. *First*, We lay it upon a clear fire upon an iron spoon till it grows white, it smoaks, grows black, and flames; we keep it there till the ashes grow white and may be blown away. *Secondly*, I put these ashes into a clear glass, pour on rain water, let 'em stand, then strain it, then exhale the water, and the water tastes saline, and leaves an earth behind, which will make, along with water, vessels to melt metals.

The use of this Process.

This water takes off all saline parts, whether fixt or volatile, but boiling does not take off the oily parts, which fly off in smook and flame, and which make the black ashes. *First*, This last oil does not disappear unless you calcine in the open air: 'Tis this oil that maintains the cohesion between the parts, which being exhaled they lose; hence there's a threefold sort of oil, a froth, a fatty substance in decoctions, and this agglutinating oil, which is only separable by an open fire; that part that subsides is an unchangeable earth; these ashes make cupels for those who deal in metal: If water be added to these ashes they grow tenacious, and with oil more so. The medicated virtues reside in the decoctions; the more dry the plant becomes, the virtue lessens; hence it is that
the

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the virtues of plants are not destroyed by the heat of the sun so long as fresh is supplied: The most boiling water does not destroy the flowers, not being capable of separating this oil of the earth; salt therefore is no part of the solids, and air by the admission of the fire only separates this oil, which the fire alone could not do. (d)

P R O C E S S V.

The Preparation burnt after the third Process gives Salt Ashes.

Let us now see what it will do upon infusions, decoctions and extracts in the third Process.

P R E P A R A T I O N.

Let the extracts be dry'd in a spoon upon a fire that is clear; they will grow black and viscus, and by degrees grow white, tasting burnt and bitter, and at last turn from black into yellowish ashes; then being kept long upon the fire, they grow white and taste saltish: Dissolve these in fair water, strain 'em, inspissate 'em, they give a brownish white, fiery and lixivial salt, which differs according to the nature of the plant and the violence of the fire.

The Use.

First then, Boiling water dissolves the oil and salt of the plant. *Secondly*, This oil and salt is the soap of the plant. *Thirdly*, The fire robs the salt of this oil. *Fourthly*, This oil gave the colour to the extract. *Fifthly*, If the water of the

(d) When we distill and burn a plant, the cover helps to cohobate the oil, that always falls back upon the earth, which keeps it black.

first

first process, the infusion of the second, and this salt be mixt, they prove an efficacious remedy. *Sixthly*, Fetid and aromattick plants scarce afford any.

PROCESS VI.

The fresh plant, or what remains after the first Process, affords salt ashes.

PREPARATION.

Place the Rosemary in an iron spoon upon a clear fire, the volatile parts exhale and leave a blackness, it begins to smok and at last to flame, so that the black oil flies off and then all grows white. *Secondly*, These ashes retain the natural figure of the plant till they come to be white, which then is destroyed. These ashes taste fiery and hot, and being diluted with water, strain'd and evaporated, they give a fixt salt.

Their Use:

First, Water dissolves the juice of the plant and leaves the solid safe. *Secondly*, Fire does not more, for it leaves salt. *Thirdly*, The water draws off the combustible part. *Fourthly*, The saline parts are not made volatile, but the oils fly off. *Fifthly*, The oil and salt are separated by the fire. *Sixthly*, Whilst the salt and the oil continue connected we are in health, but unhealthful if they separate in the vessels, therefore the diversity of plants is in their juices.

P R O C E S S V I I .

*The natural Salt of plants prepar'd from their juice
newly express'd.*

The former preparations have shewed us what the water, air, and fire, will do in plants ; now we must enquire into the natural salt of plants, but as it requires some months to prepare this salt, I will shew you the beginning and the end of the preparation, and supply the rest by explaining it : We must not suppose that this salt is in the plant because 'tis drawn out by the fire.

P R E P A R A T I O N .

First, Take Sorrel before it flowers, in a morning, wash it, cut it and bruise it, and express its thick juice. *Secondly*, Put to it six parts of water, and dilute it so as it may strain. *Thirdly*, Put this into a *Manica Hippocratis* of linen, so that it run through ; strain this often over again. *Fourthly*, Boil this liquor till it comes to be of the consistence of cream. *Fifthly*, Then put it into a broad glass urinal, pour oil upon it, put it into a cellar, let it stand for eight months ; and you will have a tartar, the liquor swimming above. *Sixthly*, Take out this salt, wash it clean with cold water, dry it, you have the natural or essential salt, differing much from the fixt. *Seventhly*, If you try this in other plants, you'll have very different salts, some nitrous, some tartarous, &c. Where any oily parts abound, as in Purcelan, &c. they must be first fermented before they afford this salt ; hence abounding oils hinder this concretion.

The Use.

'Tis soluble in water, 'tis compounded of oil and salt, which is not alkaline ; 'tis miscible with
the

The Elements of CHYMISTRY. II

the blood, and will burn in the fire and make a fixt salt.

PROCESS VIII.

The native Salt of plants produced after fermentation, call'd the Stone or Tartar of wine.

PREPARATION.

The juices of fruits being press'd and fermented are call'd wine; the dregs settling are call'd the mother of the wine: This wine being drawn off from the lees, into another cask, by degrees the *Tartar* is thrown quite round the hoghead, not to the bottom only; and if you draw off the wine again into another cask, you get more of this tartar or winestone; sweet wines afford little, Rhenish the most: This stone is red or white, as the wine is.

Its Use.

This is another natural salt, acid-oleous, calcinable into salt of Tartar: It neither dissolves in vinegar, wine, nor cold water, but in boiling water, and it settles again as soon as it cools, unless in 20 times its weight of water. In calcining it breeds air: It is good in bilious cases and acute ones; it purges gently; with an acrid and putrid matter, it is soluble, see process 54, 55. when by Analysis it will appear to contain air, water, and spirit, a volatile, and thick oil and earth.

PROCESS IX.

The Salt from the fresh Rosemary calcin'd after Tachenius's manner.

PREPARATION.

1. Place the dry Rosemary upon a frying-pan, cover it, make a fire under it, which gradually en-

b 2

crease,

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crease, it turns into a black coal, add more, burn it also, till you have burnt what you want; the cover hinders the flaming, which it shou'd; this is calcination, and the black coal left is bitter when put into water.

2. Take off your cover and burn it white, by stirring it about; the oil flying off makes it white by the air and fire, 'tis then saltish and a true fixt salt.

3. Leave it still on the fire, stirring it, it has lost its water and oils, but has earth; 'tis saponaceous.

4. Put this powder into any vessel, pour six or more parts of boiling water to one of ashes, stir them, the earth settles, and the water contains the fiery salt; strain, leaving the earth behind.

5. Exhale the water, and the salt is at bottom, which runs in the air; the browner, *i. e.* more oily, the better.

6. Put this salt into a crucible till it melt, then pour it out, 'tis *Tachenius's* salt; any plant affords the same, and has the same virtues.

Its Use.

These salts are compound salts, *i. e.* of oil and salt; they are not so contrary to acids as pure alkali's; they may be us'd as sea-salt; they run if expos'd to the air; they mix with all our humours, and even our oils; hence they pass all, *but the Nerves*; they dissolve coagulations, if we also make use of exercise at the same time; they do not dissolve the stone nor cure the gout: However, they stimulate the nerves, and help languors, hypochondriacks, hystericks, and diseases from sluggishness of the blood; they open obstructions of the vessels; promote secretions by their stimulus, and therefore promote sweats and urine, as well as stools, as costive hypochondriacks do experience.

rience. They dissolve tenacious humours in the liver and elsewhere, wherefore they are good in chronical cases, in grossness of the blood, and relax'd fibres: But in putrid, bilious, alkaline, and feverish bloods, they are dangerous.

Their dose is from 4 gr. to ʒij, upon an empty stomach; they must be diluted in 72 parts of water; if you design to help costiveness by them, give 9 gr. of Succotrine Aloes, or half a dram of *Pil. Ruffi*, and in the morning take a requisite dose of this salt in water: If you design 'em for a diuretick, omit the Aloes in the evening, and drink Tea or Coffee after the draught; if for a diaphoretick, drink it in the morning in bed, and upon it drink Sassafras Tea, common Tea or Coffee, and cover yourself close up. If you are for curing agues by 'em, purge twice or thrice, then four hours before the fit give a dose of these salts; the *Spaw* waters do only exceed these salts in their virtue.

PROCESS X.

Salt of Carduus Benedictus after Tachenius's manner.

PREPARATION.

This is done as in the ninth Process, and therefore 'tis needless to repeat it.

Its Use.

There is oil and salt in it; and as any plant affords the same, 'tis no matter which you calcine: Bean-stalks then are as good as any, they are cheapest and as good in their virtues, altho' *Paracelsus* commends the salt of these against the stone; only take care they are not rotten, as we must always observe.

P R O C E S S X I .

*The common Salt got from the fresh Plant calcin'd,
as prepar'd by the Apothecaries.*

P R E P A R A T I O N .

Take any fresh herbs, as Wormwood, Carduus, Fern, Kali, Bean-stalks, or the like, dry them, shake them to clear them of their sand, pile them up on the clean brick floor, set fire to them till all turns into white ashes, sift them. *First*, They smoak, which grows black, till they flame, which at first is blackish about; then the flame is like that of lightning; the smoak continues whilst any blackness is in the plant: *Lastly*, All the flame vanishes and the ashes sparkle; the oil makes flame and smok. The Salt made, as before, is more alkaline and fiery.

Their Use.

These Salts, according to the strength of the fire, are stronger or weaker; they are all alike.

P R O C E S S X I I .

The fix'd, alkaline, acrimonious, fiery Salt of vegetables, and their Oil per deliquium.

P R E P A R A T I O N .

1. Do as in the ninth and tenth Process.
2. Or do as in the eleventh Process.
3. Burn them till they grow white without flowing, for then you get glass and no salt; hence commentators tell us the earth will turn into glass at the general conflagration.
4. Boil these ashes with four times as much rain water, let them stand to cool and settle clear;

clear; boil the remainder over and over again afresh, till you have all the falt; then boil the whole clear'd to the confiftence of honey, then ftir till all is dry, taking care it boil not over.

5. Then put it into a crucible and calcine it, then put it into a mortar warm'd, and powder it, from thence into a warm glafs bottle, ftop it well and foon with cork pitch'd.

6. The longer this falt is calcin'd, 'tis the more fiery, alkaline, and ftiong, and 'tis of various colours as 'tis calcin'd, white, blue, green, brown, red; take care coals don't fall into it to change this colour.

7. Juices, extracts, effential falts, will by calcining turn into fixt falts.

8. Some afford falts fooner than others, as Vine-twigs, and this is *Valentine's* Antipodagrick and Lithontriptick, Kali and Tartar; Fern-afhes give a muddy greennefs to glafs, but Kali a clearnefs, fee *Murani*, *Nerius Meret*; and the *Florentines* obferve, that different alcali's mixt with Mercury fublimatè water, and falt of Steel give various colours.

9. 1st, Thefe falts are fiery and cauftick, till diluted; then they turn urinous by the fpittle. 2^{dly}, They are call'd urinous, becaufe when mix'd with Sal Armoniac, they fmell fo. 3^{dly}, Their colour differs. 4^{thly}, They feel unctuous. 5^{thly}, Apply'd to us they are cauftick, they whiten bones, they raife putrefaction and make flefh ftink. 6^{thly}, They effervefce with acids. 7^{thly}, They diffolve humours, but coagulate milk; diffolve gums, but corrode the lungs, &c. 7^{thly}, With oils they make foap. 9^{thly}, They make glafs with flints or fand, which by an acid may be diffolv'd again, as *Helmont* obferves. 10^{thly}, They attraét water and make it heavier, as alfo acid from the air, and become neutral. 11^{thly}, By long fufion they fly off,
b 4 especially

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especially if you mix bone-ashes: *Boyle*. 12^{thly}, With an acid they make a Tartar, if crySTALLIS'd. 13^{thly}, Join'd with acid, you regain the acid spirits by distillation. 14^{thly}, They penetrate even metallick vessels of iron and brass. 15^{thly}, They precipitate metals dissolv'd by acids, and sublimate is redder as the Salt is stronger: *Tachenius*. 16^{thly}, They make the juices of Violets, Turnsole, and Roses, green. 17^{thly}, They never are in plants naturally, but are made by the fire (e). 18^{thly}, After they run, put them upon the fire, they fly away. See *Part 1. of Menstrua*. Hence, 1. They destroy acids. 2. If they meet with acids in us, they effervesce, turn neutrals and stimulate secretions. 3. And stimulate the nerves, are good in vomitings, and acid cases. 4. They dissolve coagulations. 5. Viscosities are attenuated by them, and they take off spots. 6. And viscosities of the lymph, bile, &c. 7. Promote urine, sweats, &c. 8. They are good in phlegmatick and cold disorders, scurvy, rheumatism, anasarca's, jaundice, gout, dropsy, if well diluted. 9. They burn issues, are good in fomentations in gangrenes. 10. But are bad in alcalious blood, where the urine is red, or in septic juices, in the plague, inflammations, continual Fevers, &c. 11. Dilute them with 20 times their quantity of water, and give them warily.

P R O C E S S XIII.

The strongest fix'd fiery Salt made with Lime.

P R E P A R A T I O N.

Take Quick-lime one part, cover it with potash two parts, put a linen cloth over them, let

(e) How then comes it to pass that vitriols are precipitated by bitter plants?

them

them stand till the Lime cracks, add water four parts, let them stand and boil; strain the liquor cool'd through a *Manica Hippocratis*, then thicken this upon a fire, till it grows white, make it into what shape you please, stop them close up in a warm'd glass with cork pitch'd and bladder, keep it warm.

Its Use.

This Salt apply'd to the skin, within a little hole cut in a plaister, is a caustick that corrodes presently. A certain person falling into such a lixivium whilst boiling, it burnt him to the bones, and it wasted his cloaths too (*f*). A gentle fire melts it, and therefore it easily dissolves gums; this liquefaction may be the *Inceration* of the ancient chymists. If the Lime has flow'd in the air, it won't make this caustick Salt, 'tis then a neutral Salt, and deposits earth. It unites with oils, and turns them into Soap.

Cor. 1. The fire only produces these Salts, and when they run, they fly off.

2. These salts become more fix'd, according to the degree of fire; Mustard has a Salt, but then it is volatile and not a fix'd one.

3. This Salt is not natural, but factitious; for Sorrel has an acid Salt naturally, and a fixt one by fire.

4. An alcalious plant is therefore saline, but their Salt is volatile, as Garlick, Onions, &c.

5. Therefore there is a great variety between a natural and the many fixt Salts: Tartar distill'd gives out an acid and oils, when they are come off, the remainder is a fixt alcali.

(*f*) I doubt this person is too credulous here; for such causticks don't touch the cloaths, whether linen or woollen; the fire may.

6. Hence

6. Hence the native and alcali differ thus, the more oil, the less alkaline is the Salt; the opener the fire, the more oil exhales; the greater the fire, the stronger is the alcali; and Lime and others heat therefore with water; some also have more Salt than others.

7. Animals feed on certain aliments affording this Salt, yet their Salt is volatile only. See Salts of animals hereafter, and the reason why we meet with no fixt Salts in animals.

PROCESS XIV.

This fixt Salt of vegetables affords a bitter, hard, crystalline, glassy fix'd Salt, not alkaline.

PREPARATION.

Dilute any fixt Salt with water, whether cold or boiling, let them settle, and you find this glassy Salt at the bottom.

Its Nature and Use.

It resembles Sand-ever, which swims upon glass when made, it dissolves in boiling, not or hardly in cold water, 'tis bitter and friable (g).

PROCESS XV.

Common distill'd water of a fresh plant, v. g. of Rosemary.

PREPARATION.

1. We have seen what a natural heat exhales, let us now see what boiling water will elevate.

(g) 'Tis glass with some small portion of salt.

2. In

2. In the 32d, to the 36th and 86th, we shall see what fire greater than boiling water produces, now let us see what 214° produces.

3. All those Plants mention'd in the first Process will here serve the turn.

4. They are to be full grown, just before the flowers or fruits appear, in a morning, otherwise their virtues may be weaken'd or exhal'd.

5. We except where the flowers, seeds, barks, or roots are aromattick, as Roses, Lilies; Cumin, Anise, Carraways; Telephium, Caryophyllata, &c. for then these may be taken apart and distill'd.

6. Cut or bruise the plant, add water to it, put them into an alembick, let more than one third be full; lute all with paste of Linseed, flower and water, distill; fill the top with water.

7. Digest with a heat 150° for 24 hours, then boil the water with the fire under it, as you will hear by the hissing noise, or by the heat of the beak of the alembick; let it drop fast; but take care the alembick be not too hot, change then the top-water; have a care the plants stop not the pipe.

8. Let the water drop no longer, than it is milky, the clear water that follows is acid, and corrodes the still; hence change your receiver often to see if 'tis no longer thick; this acid water is a colicky poison, and is cur'd by milk.

9. The heat makes the oil rise with some acid, and makes the water muddy, the odoriferous parts are in this muddy water, the virtues reside in this water: If then the botanist gives the virtues of plants, the chymist may do it by art, and tell why they are of such virtues. In this water resides the *Spiritus Rector*, and in Mint-water distill'd there is not the whole virtue which there is in the juice.

10. The latter water has an acid in it which will corrode brass, and it is cooling: All plants have

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have this acid water in 'em, which is distill'd with 215° of heat.

11. Care must be taken lest these two waters be mixt together.

Its Use.

We learn by this degree of heat what the plant parts with. *First*, The water of the first Process. 2. The volatile oil or the oil with its spirit. 3. The acid salt. *Secondly*, We know what remains at the bottom. 4. The extract of the 3d Process and all that's prepar'd from it in the 4th, 5th, 6th, 7th, 9th, 10th, 11th, 12th Processes. *Thirdly*, We know that the smell and taste reside in the volatile oil and spirit. *Fourthly*, We know what exhales by boiling in the kitchen and in pharmacy, and what remains. For Bawm and other aromatics boil'd lose their flavour. *Fifthly*, Whilst aromatics are boil'd, two parts ascend, first the aromack, then the acid. *Sixthly*, Hence we are directed to distill, for whilst the milky part comes off 'tis aromack, when it begins to be clear 'tis acid; however, plants without smell are of use when distill'd. *Lastly*, The plant, that is the solids, remains unhurt.

P R O C E S S X V I.

The common distill'd water by an alembick repeated and cobobated upon fresh Rosemary.

P R E P A R A T I O N.

1st, By this Process we are taught to make the virtues much stronger. 2dly, We take all out of the still, press out the water, put in fresh herbs, and add the distill'd water along with as much more common water as will distill it. 3dly,
We

We close the vessels, digest in 150° of heat for three days and nights, to extract the virtue. *4thly*, We distill slower than before, when half is drawn off we encrease the fire. *5thly*, We distill so long as the water is white, and thus we get a strong and odoriferous water; the oftener we distill and cohobate, the stronger 'twill be. Thus I distill'd in 1730, 14 times, and got a very refreshing cordial water, what remain'd at bottom was austere; and if we mix these two waters, we have a compendium of the virtue of the whole plant; and thus extracts may also be made that have the whole virtue of the plant. *6thly*, Thus we have the collected virtues of the plant, which may be encreas'd at pleasure. *Paracelsus* said, they would make old people young, so said *Isaac Holland*. I have try'd such waters in myself, and have found 'em very comfortable; they are good where the spirits are affected, and in hysterycks and hypochondriacks; and Mint cohobated three or four times, helps a weak cold stomach, and I have known it to take off a lientery quickly: I have distill'd such a water from the peels of Lemon, that helps flatul's and palpitations of the heart, and languors, in a small quantity; and such a water from Wormwood kill'd worms, and supply'd choler: The boughs of Savin treated thus move the menses and the hæmorrhoids, warm and move the nerves violently; and for Rue-water thus made, I know not how to praise it enough for all the virtues Rue has. Thus have I treated other plants, and have done great good therewith, I will therefore give some rules about them.

First, Aromatick, balsamick, resinous, gum-resinous, and fetid plants, such as *Arbor-vitæ*, Orange, and such like, dry'd in the shade, digested in 150° of heat for 72 hours, give most excellent waters.

Secondly,

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Secondly, Hard and ponderous things must be macerated in water for six or seven weeks, in 96° of heat, to which you must add a little salt to hinder the putrefaction.

Thirdly, Plants which easily give out their smell, as Jessamine, Lily of the valleys, and such like, as also Sassafras, must be distill'd immediately.

Fourthly, Astringent and emollient plants are of no use when distill'd.

Fifthly, 'Tis quite otherwise in those plants where their virtues fly off in 214° of heat, for in those decocted or extracted there is no virtue, as in Lavender, Lily of the Valley, Rue, &c.

Sixthly, In some plants there is virtue both in the water and decoction, and therefore both may be united, as Wormwood, Carduus, &c. and these being fermented give spirituous waters.

Seventhly, The acid, bitter, austere, sweet, and mucilaginous plants are best in extracts; in Chamomil and Wormwood something ascends, the Chamomil is blue, the Wormwood green; soaps afford nothing: See the catalogue of the plants of the second Process, &c. let us then distinguish between the contrary virtues in each plant: For example, the first water of Cinnamon is warming and opening, but the second is cooling and binding.

P R O C E S S X V I I .

Common distill'd water of the fresh herb of Rosemary after fermentation, after Ludovicus's manner.

P R E P A R A T I O N .

First, I have already shew'd you what the fire, so as to boil water, will produce; now I will shew you how waters may be made more penetrating and volatile: For this purpose take fresh Rosemary,

mary, as in the first Process, let it be cut and bruis'd, fill a hoghead with it, so that you leave four fingers breadth empty; take as much water, fill it till it comes up to the Rosemary, put to it an eighth part of honey in the winter, and a twelfth in the summer, or sugar will serve the turn; to each pound of water put half an ounce of Bawm; this water should be put to the herbs warm, cover the hoghead, put this hoghead so as that it may be warm'd to 80°, cover it up with blankets to keep it at this warmth; the winter requires it to be nearer the fire, but the summer heat is sufficient; the second day it will begin to hiss and bubble, this motion is call'd fermentation.

Secondly, Let this fermentation continue till the plant subsides, then let the barrel cool and stop it, or the spirits will fly off.

Thirdly, Take as much of this herb and liquor as you please, put it into the distilling vessel and distill gently, for too much haste makes it boil too much: Distill so long as the water is odoriferous and milky, for the clear part that follows is of no use; in the bottom is the extract, which is of no use.

And all these things happen thus, if the fermentation be perfect, so that the herbs fall the 5th or 6th day to the bottom. This first water will keep for years, without any mother; it grows milky in water, it keeps its taste and smell; but if you mix too little honey, or protract the fermentation too long, it is not so good; at length the acid water ascends without smell, and the extract is at bottom: In the first water there is oil; if the fermentation be continued for one or two days, an oil swims at top; but the longer it is fermented, the less oil appears.

Fourthly,

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Fourthly, In the first distillation a clear spirit ascends, then a milky water, then the acid water.

Fifthly, The more perfect is the fermentation, the less virtue has the extract.

Sixthly, The oil in the first water is so attenuated, as to be call'd spirit, yet it grows milky with water, and will swim at top.

Seventhly, By a perfect fermentation these waters are limpid, the oil being highly attenuated and chang'd, and their virtues are not so good as by cohobation, nor so good if too much fermented, because the spirit flies off. Hence the spirit flying off, these are not so good as by cohobation.

P R O C E S S XVIII.

The common water of fresh Rosemary distill'd by descent.

P R E P A R A T I O N.

Distillation is only when by fire matter is translated from one vessel into another; this is done three ways, directly upwards, obliquely by a retort, and by *descent* or downwards. They take any cylindrical vessel, deep and strong, and bore it at bottom with several holes, let there be a rim that has a circular groove, and a cover for it; put the herb into this vessel, cover it with its cover which goes into a groove, clay them together, cover the top with ashes, then make on a fire, and distill into a pot under, as into a receiver, and all goes into that receiver; take care there be not too strong a fire; thus we get the water out, but it is now in disuse. *See a further description in Libavius.*

P R O:

P R O C E S S X I X .

From the remainders of Process 15, 16, 17, 18 burnt, the saline ashes as in Process 5, 6, 9, 10, 11.

First, If the remains from the 15th Process, both plant and liquor, be dry'd and put into a frying-pan and burnt, as in Process 6th, into white ashes, then from these ashes you may get a salt, the same as from the fresh plant; or if you take the remainder and mix it with the herb's juice and manage them as in the 5th Process, you get the same salt still; distillation then does not lessen this salt, if putrefaction do not intervene.

Secondly, If we take the remains of the 16th Process, whether juice or herb, or both, we get a salt doubly saltier and double in quantity; hence art excels nature (*b*).

Thirdly, If you take the remains of Process 17th (*i. e.* distill'd without sugar or honey, for they burn spongy and afford no salt) and burn them, you get the same salt, as Tartar from wine.

Fourthly, The remains of the 18th Process burnt produces so much less salt, as there was more soapy matter in the water, which without that matter would have produced the same quantity of salt.

Fifthly, Hence, 1. The elemental water of the plant; 2. The spirit; 3. The volatile oil, in water 'tis white, alone, which swims in plants not united; 4. The acid, or vinegar of plants, 'tis

(*b*) How can this be ?

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even in aromatics, the fixt parts ascend not as the fixt oils, the fixt salt, and earth (i).

P R O C E S S XX.

The express'd oil of plants, as of Almonds.

P R E P A R A T I O N.

1. This oil is inflammable, altho' it grows thicker the longer it stands, as in oil of Turpentine, Wax, &c. all which melt with fire. 2. The oils in plants are various, the volatile oil holds the *Spiritus Rector* and the peculiar virtue of the plant; this once separated, the plant is no more of its usual force. 3. This oil is reserv'd in certain adipose ducts, and may be seen by cutting Firr, &c. Nutmegs, Almonds, and may be express'd. 4. This oil is for the defence of the plant from cold, and it is found most abounding, as the parts are distant from the root, as in seeds of Line, &c. 5. It is for the defence of the plant, and is found most in ever-green and northern trees, in the apples of Pine, &c. 6. It is found most in old plants, and if spring and summer be the watching of plants, and autumn and winter their time of sleep, we may say they breed oil in the time of sleep: Lime at its budding is green and all watry, but when it grows brown, then it contains most oil; and the same may be said of all. 7. Hence if chymists want oil, let them gather in autumn

(i) Since from what is said in the foregoing section, distillation does not lessen the fixt salt; then they must have sixteen times as much salt, altho' the salt will be, in equal quantity, equally salt, or the author must allow of penetration of parts, which is impossible, and therefore false; there is no wonder then that more salt should be afforded, but it would be strange, that the salt should bulk for bulk be stronger without a penetration of parts.

and

and winter; if salts and water, in spring and summer: Hence builders chuse to cut their wood in winter, because their oil preserves the wood from receiving rain; ripe seeds have the most oils, they may be powder'd with their own bran; but if they are too fat, they may be express'd by moistning their powder with the steams of warm water, and putting them into the press, and receiving their oils, as in Linseed, Almonds, Nutmegs, &c. None of these oils, tho' of Mustard-seed, are hot, but smooth; and I wonder'd at this at first, when I saw Mustard-oil prescrib'd with success for the stone; and you may be surpris'd that the *Spiritus Rector* does not manifest itself here. 9. There is so little of salt in express'd oils, that they are vulnerary and a little styptick, and so they cure fresh wounds and hinder the ouzing of matter. 10. These oils, if they grow rancid, or even are kept for some hours, from soft, anodyne, thin, insipid, sweet, and white, they become sharp, corroding, thick, bitter and yellow (*k*).

PROCESS XXI.

These native oils being mix'd with proper substances, become milk, chyle, emulsions, as Almonds.

PREPARATION.

1. Beat the matter in a mortar, till it grows pappy and whitish, by pouring a little water to it.
2. Pour on more water, still stirring, pour out all the milk.
3. Pour on fresh water, and thus pour in water and decant it so long as it affords milk.

(*l*) All these oils are one and the same, and are only diversify'd by their adjuncts; but when authors love splitting and dividing, let them take their swing: 'Tis better for the printer, but the bookseller or reader pays sawce.

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4. This liquor resembles chyle, made in this manner by the stomach, it separates like milk into a thin bluish matter and cream, and it grows sour as milk does, but I never could get cheese from thence; the oil express'd does not unite with water as this does, but parts tho' shaken with water; the whiter, the more oil there is in the liquor; emulsions in summer keep not above 10 hours, but longer in winter; all corn ground, put into the mouth grows white by chewing, and is chang'd by fresh mixtures in our vessels.

P R O C E S S XXII.

Oils of plants prepar'd with water by boiling.

P R E P A R A T I O N.

1. Plants being prepar'd according to the 20th Process, sew up the remainder in a linen bag, put it into boiling water, you get oil, continue the operation till no more oil can be got by a spoon; the last Process shew'd us this oil, the water is oily. 2. But if we take the thing prepar'd by the 20th Process, before the oil is express'd, and boil in water, we get much oil; thus ℥j of Cocoa-nut bruis'd, and boil'd with ℥viii of water to the thickness of a poultis, the salt collected and cool'd was seven ounces *Homb.* and the remainder boil'd and press'd affords oil. 3. But some, as Beans, Lentils, and Pease, afford no oil thus, unless by burning.

Their Uses.

These three experiments shew the native oil in plants; and we learn from whence we have fat in us. 2. We see the use of it in plants. 3. Hence we see the nature of milk and chyle. 4. We see what essentials must be. 5. Hence we see why a vegetable

vegetable diet will make us fat, for by chewing and diluting milk is made. 6. Hence we see how our humours extravas'd grow sour; hence we grow fat with bread and water, as oxen with grafs and water. 7. Hence art cannot produce more oil than nature does; these oils got by boiling and expression are not pure oils, because distill'd they divide into water, salt, foot, essential oil and earth; hence they change in the air.

P R O C E S S XXIII.

Essential oils, or distill'd by an alembick from the leaves or green boughs of Savin.

1. All plants will yield these oils, but we speak chiefly of odoriferous green, or evergreens, or decaying plants. 2. The evergreens are Fir, Arbor-vitæ, Orange, Box, Cedar, and the like, which are always full of oil, especially in fall and winter. 3. Plants that are full grown and aromattick afford these oils with more difficulty. 4. Experience shews us that these aromatticks give out more oil when gently dried, than when they are newly pluck'd, but this rule is not general, for Mint and Rosemary give most oil when fresh, so Calamint and Ageratum. 5. Some need only be put into the still with their own distill'd water, as Wormwood, &c. but others require maceration with salt or oil of Vitriol for three weeks in 90 degrees of heat, such as Firr, and all hard evergreen plants, as Savin, Box, &c. 6. Then distill as in Process 15th and 16th. 7. By this method the cases that held these oils break and the oil is driven up, retaining the natural smell and taste of the plant, which now has not its usual taste, and these are essential oils.

Their Uses.

Their acrimony is plain from their being apply'd to any wound, or if long apply'd they blister; their warming faculty is prov'd from their raising a heat, nay even sores, in us; hence they are good in all cold cases from phlegm or acid or watry constitutions, such as anasarca's, phlegmatick indigestions, colicks, intermittents before the fit, cold apoplexies; and as they refresh the spirits, they revive old men, and all actions depending on them, failures of spirits, hysticks then and hypochondriacks are profited thereby; but for plethorick or feverish cases, they are bad.

Hence we get aromattick oils by the help of boiling water; the spirit resides in these oils, and will remain, if close stopp'd up; each plant contains a certain quantity; salt makes boiling water hotter, and you get more oil thereby, but no more spirit, for that comes over easily: This oil is easier got than volatile salts, which require exustion; nothing but this oil demonstrates the plant from whence it came; we lose then much by coction.

P R O C E S S XXIV.

*Distill'd oils from the dry leaves prepar'd by a still,
from Mint.*

P R E P A R A T I O N.

The same experiment may be tried upon Mint, which gather'd and put dry into the still, it must be half full, pour its own water to it, and we shall gain an oil, having the smell and taste of Mint, swimming upon the water; and if we press out all the juice left, and put this distill'd water to
it

it again, we get more plenty of oil, and the oftner we cohobate the more oil we get.

PROCESS XXV.

Distill'd oils from the flowers of Lavender.

PREPARATION.

We take the buds of Lavender Flowers in the morning whilst the dew is upon 'em, we fill two thirds of a still, and pour upon 'em their own distill'd water (and a little oil of Vitriol) which is very fragrant; if we press out the juice and distill over again, we get more oil, and the more we cohobate the more oil we get. This oil is scarce, and must be prepar'd with oil of Vitriol lest it putrefy; thus it will give a third part more oil than usual; thus may all aromatics be treated.

Their Use.

'Tis only for the use of princes, for their fragrancy.

PROCESS XXVI.

Distill'd oils from the seeds of Fennel.

PREPARATION.

There is often a great deal of oil contain'd in the seeds, but it does not always happen that this fragrancy is in all parts of the plant, for in Aniseeds and Cummin the seeds are fragrant, in Roses only the flower, in Oranges the flower, peel and the leaves, in Cinnamon the bark only: Hence you must know what parts are fatid or aromatics, to afford these oils; then the seeds must be ripe, dried for three weeks, and digested for three days

in warm salt water, and the fire must be stronger, we must take care that the serpent or worm thro' which they distill be not too strait, and if we find a stop by the congealing of the oil, we must pour into the barrel boiling water, and if this does not do, we must cease from distilling. In warm countries their oils are very thick, as in Camphire.

Their Uses.

These oils are found mostly in the roots and seeds, for defending 'em from the winter's cold; many of these oils are not aromatick, it may be the fine spirit flies off and deceives our senses, and 'tis certain this fragrancy is soon lost, as we perceive in aromatics imported from the *Indies*, as Cardamoms, &c. whilst Acacia, Tamarinds, Senna, &c. remain safe. 'Tis remarkable that these oils are kept from flying off for a long time, but so soon as they are water'd they are prepar'd to fly off; hence water conveys these oils to the parts.

P R O C E S S XXVII:

Distill'd oils from Cloves.

P R E P A R A T I O N.

These Cloves, if prick'd with a needle and press'd, will sweat out an oil, which is burning and odorous; the fresher, the more they afford: Put these Cloves into the still with twelve times their weight of water, and let them gently drop thro' the worm; when you have thus drawn off two thirds, change your recipient, and put in more water to the Cloves; and thus pour on more water, and distill so long as the water is muddy; the water that comes off clear when it has ceas'd to be muddy, is an acid water: These Cloves appear whole after

after distillation, and the merchants, by putting them among fresh Cloves, put them off to sale; they attract a fresh oil from the fresh ones. Or if this oil appears too muddy, and you fear it should, you may first digest them with salt for a fortnight or three weeks.

Its Use.

This oil is vastly heating and caustick, is good in cold distempers, in failures of spirits, &c. If this oil be expos'd to the air, it loses its flavour, and becomes a thick oil, it sinks in water, and this we have observed in the oils of Cinnamon, Guaiacum, and Sassafras; heavy as it is, 'tis lifted up with water, and 'tis remarkable that these oils should afford an acid at bottom.

P R O C E S S XXVIII.

Distill'd oils from Sassafras.

P R E P A R A T I O N.

The light odoriferous woods shav'd and put into the still with twenty times their weight of water, they afford oil and a milky water, which we must distill as long as 'tis milky, the last water being acid; you may distill fresh wood over again with the former water; the oftner we cohobate the more oil we get, the same oils are distill'd from other woods, which swim upon the water, this sinks. The more ponderous woods must be digested with salt and water, or brine, such are Arbor-vitæ, Box, Guaiacum, and such as afford *Bals. Capivi, Peru, Tolu, &c.* The longer they are digested, the more oil they afford; the more solid and ponderous afford much of this oil, the lighter the least; of this last sort are Alder,
Poplar,

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Poplar, Willow, Lime, &c. those that are cut whilst they are growing afford least oil, but in the winter afford most; hence young trees afford less than old ones, and ever-greens more than others; hence those that afford most oil are best for building; wherefore the weight of these trees depends upon their oil, as does their duration and hardness; hence worms feeding upon this oil rots the trees; hence changes of weather exhale this oil, and make 'em rotten, such as Cedar, Oak, Guaiacum, Fir, &c.

P R O C E S S XXIX.

Distill'd oils from the bark of Cinnamon.

P R E P A R A T I O N.

You take the bark of Cinnamon, and distill as before; you get from thence an odoriferous oil, and also a yellow oil; you distill so long as the water is milky; but when the acid comes, you must leave off; the first water has the virtue of Cinnamon, the latter none at all. The acid water corrodes the still, and is emetick and anti-helmintick, the Cinnamon that is left is of the same colour as when put in, but has lost all its taste; but if 'tis placed among other good Cinnamon, it will re-acquire its taste, and rob the other in proportion; if you distill the remaining Cinnamon with fresh water, you get more oil by this cohobation: As this oil is worth near its weight in gold, and something mucilaginous sticks to it, it had better be distill'd with salt water or urine, or oil of Vitriol. The remainder of this Process being burnt, it affords little or no fixt salt, and the decoction describ'd in the second member of this Process affords an austere water
and

and extract, and being burnt affords little fixt salt; hence 'tis to little purpose to mix this salt and its oil, in order to gain an essential salt.

Its Uses.

Chymists labour in vain, when they tell us they can draw much oil from this bark; 'tis very fiery and caustick, both externally and internally; yet 'tis very refreshing; those brought from *Ceylan* harden into a salt that dissolves in water. *Slare* tells us so in *Phil. Transf.* 111. 362. However, if the bottles are not well stoppt, it loses its Force.

PROCESS XXX.

The distill'd oils of Cloves by descent.

PREPARATION.

Chance taught us that plants put upon the fire, do sweat out something oily; hence a method was found out of making pitch; at length aromatics were treated after this manner. I will shew you an example. Take Cloves, bruise 'em to a pulp, put 'em into a proper glass vessel inclosed in a linen rag, fit the top to this glass, strew it over with ashes, place under it a vessel to receive this oil, make a fire of a sufficient strength, and the oil and water will descend, and the work is over.

Its Uses.

We learn by this experiment to get the natural oil, which has all the virtues of other essential oils; 'tis not got so plentifully as with water, and the remainder serves for other uses, retaining still a good deal of their former virtue. This
is

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is a good way to try the experiment of gaining oil on a sudden, all aromatics may be treated in this manner, and to make them sweat out of their own accord, tho' more would be got by pouring on water, those by descent are most aromatick.

Scholium.

This history of drawing of oils has very useful things in it, for Chymistry, Natural Philosophy, and Physick. 1st, It extracts all the virtue of the plant, as to its aromatick parts. 2^{dly}, In this oil resides the spirit which is to be distinguish'd from the oily part, and the remaining oil may be thicken'd into a balsam; hence *Bohnius* thought these distill'd oils were liquid resins, and trees that contain oil, by being prick'd, sweat it out, and at last by losing its spirit they grow into resins. Thus Turpentine loses its spirit by being boil'd; hence Gums by growing thick lose this spirituous part, and the more thin they are, the more virtue they have, because they then retain their spirit; the taste depends upon the salt, but the smell upon this oil. 3^{dly}, The more penetrating is the smell, the stronger is the spirit of this oil; but when dry'd, they have the less of it: This spirit sometimes abounds with a small quantity of oil, and in others the oil has less spirit; this makes the difference betwixt Nutmegs and *Calamus Aromaticus*, where a pound of the nut affords an ounce of oil, and 25 pound of the latter only affords the same quantity; 'tis this spirit that gives to each particular plant its peculiar smell; I've enquir'd into the quantity of this spirit, but could not determine it: Savory and Thyme have most of it. 4^{thly}, The oils are of various colours, brown from Mint, yellow from Lavender, golden from Cinnamon, blue from Chamomil and Mille-

Millefolium, white from Aniseeds and Camphire, from what principle we can't tell. *5thly*, Some of these oils are very liquid, as of Oranges, of Lavender, of Sassafras. Others thick, as Fennel, Roses, Carraway-seeds and Camphire, but all melt with different degrees of fire. *6thly*, They are of different weights, the heavy ones are of Cinnamon, Cloves, Sassafras, Nutmeg, &c. others are light, as Lavender, &c. but this weight does not depend upon the consistence, for Camphire is thick but light, Sassafras is heavy but thin; that of Aniseeds stands in the water, that of Juniper subsides. *7thly*, These aromatick oils are hot, refreshing, attenuating, and stimulating: They are good in cold, phlegmatick, watry, intermitting cases, in hysticks and hypochondriacks, and in flatulencies, colicks, and iliack passions, and refresh the spirits of old persons; but are bad in hot and inflammatory cases, and become poisons; and all these virtues depend upon the spirit: They produce an acrimonious taste in the mouth, and applied to the skin will inflame and make gangrenes, particularly where the parts are bar'd, or to the lips, nostrils, &c. hence they refresh and heat; where people lead sedentary lives they heat not so much, they are therefore dangerous in ardent fevers, they make the spirits circulate and dissolve the blood; in this case the cohobated distill'd waters are best, the oils of Arbor-vitæ and Savin, are strong emmenagogues; of Rue, antihysterical and antiepileptical; of Juniper, antiscorbutick and diuretick; of Mint, stomachick; of Lavender, antiparalytick and antilethargick, and good in vertigo's; of Roses, cardiac; of Cinnamon, to promote labour; of Wormwood and other bitters, antiphlegmatick; of Palm and Lemons, good against palpitations from cold humours; of Marjoram, Rosemary, and Sage, against whites. *8thly*, These oils become limpid if

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if they are divided with three parts of salt and distill'd over again, the gross remains behind, but some part of the virtue is lost, as appears by *Homburg's* experiment, where by 26 distillations with fresh water, part turn'd into an insipid tenacious matter, but the water became very spirituous, *Hamel. Hist. ac. R. 143.* 9thly, By distilling them over again they always afford something of water, and grow lighter and more limpid, and leave at bottom something terrestrial, and *Mr. Boyle* says is turn'd most into earth. 10thly, *Burdelin*, according to *Hamel, Hist. ac. R. p. 413.* says, That by distilling five ounces of oil from 15 ounces of chalk eight times together, they got but two ounces and a dram of oil, two drams and four grains of salt, and an ounce and half of water, in which did reside a volatile salt. 11thly, By distilling a pound of oil six times from *Lime*, they got 15 ounces and 1 third of water, and one ounce of oil; hence do these oils consist of water, earth, salt, and a little oil. See *ac. R. Sc. 1073. p. 37.* hence oil is a compound body, but shall not define whether there be any transmutation. 12thly, I know that these fine oils being dissolv'd in alcohol and digested, and then distill'd by the heat of a 100°, they do communicate their spirit to the alcohol, and leave behind a tenacious oil at the bottom; and this they do if the distillation is repeated with a new alcohol, and then the oil is left insipid at bottom, and thick; nay, water itself being toss'd with these oils, 'twill be impregnated with their flavour, and leave the oil vapid. We see then that oils are divided into spirit and oil, and 'tis wonderful that Water impregnated with this spirit does not lose it by 20 distillations. 13thly, Hence the peculiar taste and smell of plants depends upon this spirit; 2. the smell and taste of distill'd waters depend upon this spirit; 3. that

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that of the oils also depends on this spirit; 4. the fixt oil is for the solid parts of the plant, the volatile oil supplies the spirits; 5. the express'd oils and distill'd ones are natural to plants; 6. the difference of the oils is from the spirits. See *Hornberg* and *Hoffman*, from Page 1 to 63.

PROCESS XXXI.

Rob, produced from the remainder of the Processes from 23 to 29.

PREPARATION.

Having got the oils off from the plant, and the more they have been call'd off the better; we take the remaining decoction, dilute it with water, strain, and evaporate to a thickness like honey, and this is *Rob*, which keeps for years; it may be made from Wormwood, &c. Juniper, &c. burn this, it makes *Tachenius's* fixt Salt; put oil to this *Rob*, and you get the essential salt.

Its Uses.

Thus we have preparations, which if blended all together again, we have the whole virtue of the plant, except of the earthy parts, viz. mix oil of Juniper with its salt and *Rob*, dilute all with its water.

PROCESS XXXII.

Distill'd oils, acid, spirit, two oils, coal, ashes of Guaiacum from a retort without any addition.

1st, All plants do yeild either an acid-oleous or an alcalino-volatile oleous salt; I shall speak of the acid first of the Guaiacum; 2. we put the
thavings

shavings of it into a glass retort, we fit a recipient, lute it with Linseed, Flower and Water, we place it in a sand-heat of 212° of heat, and draw off an acid water, unlute and pour it out; lute again and encrease the fire, you get an acid spirit somewhat reddish; unlute, pour it out, lute and encrease the fire, and we get a red very acid spirit, and no oil; augment the fire, we get a thick black oil, and at last a pitchy oil; 3. strain these several spirits, smelling like red herrings, through cap-paper, wetting it first with the spirit, and the oil won't pass through; 4. if we pour it on chalk it huffs, if we rectify, the oil separates, if it stands also it subsides, therefore this is a mixt spirit consisting of oil, water and acid; 5. to get the oil pure, rectify with water; 6. burn the coal at bottom into ashes, and you get salt of the first kind, if the wood is fresh, otherwise none.

Its Uses.

1. We learn hence, that when green wood sweats at the end upon burning, this moisture is an acid water, that hurts one's eyes. 2. The next juice in smoke is a stronger acid, and hurts the eyes more, and dries Mint hung in a chimney and preserves it and colours it. 3. The last smoke hurts the eyes most, it is the strong acid and oil, it also preserves Mint. 4. Hence vegetables give an oleous acid water, that is penetrating, antiscorbutick, diaphoretick, &c. 5. It appears how water will cling imperceptibly to bodies, tho' they seem dry. 6. We see how without it, bodies become mouldering, and how different the body is from its components. 7. We see how water, acid, oil, spirit and earth are united to produce plants, and will last there for ages. 8. We see how the coal remains black, till burnt in the open air, so that air and fire were requir'd to gain the
the

the last oil. 9. All plants do the same; the vine, cut in *March*, gives an acid, and burnt, a fixt salt.

P R O C E S S XXXIII.

The water, spirit, volatile oily salt, oil, coal from Mustard-seeds distill'd from a retort.

P R E P A R A T I O N.

'Tis well known that some plants cut or bruis'd do emit a steam, that pierces the nostrils and makes us sneeze, and forces tears from us. Such are *fetids*, as Garlicks, &c. strong acrids, as Mustard, Horseradish, Scurvygrass, &c. Tobacco and many others. 2. I put Mustard-seed just ripe into a glass retort, near fill it, join the recipient, and put fire to it, we get an acrid water and oil; keep these apart; join the recipient again, we get, by encreasing the fire in sand-heat, a light black oil and a volatile salt like hartshorn, and behind is left a spongy earth, bitter, not salt. 3. Redistill the first water, 'tis a volatile spirit. 4. Pour out the oil from the salt, and wash it with the spirit, distill, you get a volatile salt, that effervesces with acid and is like hartshorn. 5. The oils become more grateful by rectification, as also more pure. 6. The coal that remains at bottom being put upon the fire and calcin'd, affords no fixt salt; but I am told that being put into an earthen retort, it will like urine afford a phosphorus. 7. These plants agree in their analysis with animals, and afford the same principles; hence volatile salts are not peculiar to animals alone; nay they appear plainer in plants, for Mustard-seed will effervesce with vinegar, but urine of animals will not; and we get a volatile

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salt from 'em without putrefaction. 8. Hence these plants are useful in phlegmatick, acid, and watry constitutions, and promote the circulation; consequently they're bad in inflammatory and warm diseases.

P R O C E S S XXXIV.

The separation of oils from other things in distillation, and their changes into balsams and resins.

P R E P A R A T I O N.

This separation is made several ways; first, by filtration, which is done by cap-paper folded into a conical figure so as to fit a funnel, then you wet the paper with the spirit and pour in oils and all together, the spirit and salt passes through, but the oil does not. *2dly*, For more precious oils you pour in all together into a glass tunnel, holding one's finger at the bottom; then letting the oils rise to the top, you let go your finger gently, the spirit will run into your receiver, and thus you continue to separate till you see the oil ready to come. *3dly*, But if the oils are heavier than the spirit, then you do the same thing, but the oils run out first. *4thly*, If any thing still remains of the water above the oil, you can take it off with a thin cloth wet with the spirit.

The Uses.

1st, These oils must be kept and stoppt close, and to make 'em pour better, mix a little alcohol amongst 'em. *2dly*, These oils grow thicker and resinous, especially if by often opening they lose their spirit; this I remember to have happen'd to me after keeping three or four years. *3dly*, The convenience of their thickening is, that they
may

may be kept and carried a long way. 4^{thly}, Many adulterate your best oils, by mixing 'em with oil of Almonds or Poppies whilst they are distilling, and others put alcohol to 'em: The first cheat is discover'd by mixing warm water with 'em, for then the light oil of Almonds swims, whilst the heavier settles; or by the mixture of true alcohol, which joins in with the essential oil, but leaves the other. The latter deceit is discover'd by pouring it into water, the alcohol mixes with the water, and the oil separates.

P R O C E S S XXXV.

*Vinegar, spirit, double oil, resin, and colophony,
distill'd from a retort, from Turpentine.*

P R E P A R A T I O N.

Let us now examine oil of Turpentine; put Turpentine warm'd by warm water into a pipkin till it runs, pour this into a retort well warm'd with a wide neck, so that one 3^d be empty, taking care it stick not to the neck, put this glass retort upon a sand-heat, and lute. 2. Make a fire that will heat it to 100° , and distill till nothing more comes; this liquor is gratefully acid, and will effervesce with Chalk, and is very penetrating; this first liquor is call'd the etherial oil of Turpentine. 3. Encrease your fire to 212° of heat, and you will have a spirit much like the former. 4. Change your recipient, encrease your fire, you will then get more acid water and an oil,

(1) Sugar flames, because it is oil and acid, which being let loose do always ferment or effervesce; and this is evident in so compound a body as antimony, as will appear in the sequel.

and what remains at bottom of the retort, when cold, is a hard substance. 5. By augmenting the fire we get a thick red oil, little remaining in the bottom of the retort. 6. Great caution is to be us'd in this distillation, lest the glass crack and the flames burst out, which are hard to be extinguish'd. 7. This acid water, ethereal oil, or spirit of Turpentine, is distill'd otherwise; they put Turpentine into rain-water, and distill from an alembick, you get the acid water or spirit, and the oil and the colophony remain in the still in the water, and you may render it odoriferous by putting Lavender into the still; Turpentine therefore is a compound body. 8. The more we distill, the remainder is the thicker.

Its Uses.

1st, We see in plants there is this acid water, this oil, and this balsam, which last may be made thin with the yolk of an egg; nor do these balsams differ so much in virtue as in price, for they all may be resolv'd into the same principles, thus Opobalsam, Copaiva, Peru, Tolu, Mecha, answer the same ends. 2^{dly}, In all these there is an acid water or spirit. 3^{dly}, The light oils are very penetrating, and are anodyne and consolidating in nerves and tendons; and Mr. Young the surgeon, in his *Triumphal Chariot of Turpentine*, stops a bleeding by hot oil of Turpentine: This oil preserves from putrefaction, but 'tis apt to grow thick; it discusses and mollifies, and is anodyne; internally it warms, promotes secretions of sweat and urine, gives the urine a violent smell; if you rub the spine of the back with it in quartans, 'tis often a remedy; it stimulates venery; 'tis good in gonorrhæa's, but take care of too immoderate use, lest it inflame, or produce a diabetes. 4^{thly}, The thicker oils are more anodyne and consolidating,

dating, this oil with *Glauber's* spirit of Nitre will raise a flame. 5^{thly}, The remainder at bottom is a resin that is pellucid and red, and crumbles; and if you melt this and put any insect into it, it will harden and keep like amber, so that the insect may be seen thro' it: This colophony is good in bones that are bar'd, or in tendons and muscles that are hurt by burning; it stops a sharp flux of humours that flows from the joints, and is styptick. 6^{thly}, The acid is the same as in other plants; a balsam is chang'd into resin by expelling the water, the acid, and the oil; thus we see it happens by the heat of the sun, and winter makes resins of oils. 7^{thly}, Hence, 1. The great heat of the sun changes oils into resins. 2. The heat of boiling water does the same. 3. This colophony with 280° of heat, will turn into acid and a red oil, and there remains a very hard colophony at bottom; however, by a heat that will almost melt glass, this colophony is melted into oil. 4. We see therefore the force of the fire upon oils, by a small degree of heat they are evaporated to a thick consistence, but by a greater into a thin substance.

P R O C E S S XXXVI.

Water, vinegar, fetid spirit, and butter, got by distilling wax from a retort.

P R E P A R A T I O N.

1st, There is a sort of balsam upon Rosemary and some other plants, which can hardly be gather'd by us, but may be view'd by a microscope; wax therefore seems to be a sort of Turpentine gather'd by bees, and pedefactur'd into honey and wax by them. 2^{dly}, Cut such wax into
d 3 small

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small pieces, put it into a retort, make it half full, put it upon a sand heat. 3^{dly}, Distill gradually, and the acid water and spirit will come forth. 4^{thly}, When by 214° of heat no more comes out, change your recipient, and a thin oil, hardening afterwards into butter, will come up: Always remember to mix sand with the wax, to hinder its expansion.

Its Uses.

Wax therefore resembles Turpentine, and 'tis all inflammable. Melt wax in boiling water, pass it thro' a linen cloth, spread it into small fleaks, expose it to the air, sprinkle it often, it becomes white wax; hence oils are manifold, as oil, balsam, resin, pitch, tears, wax, butter; the fire makes oils to appear; this butter never returns into wax, as I found by keeping it for 20 years together, mean while oil of Turpentine will return into Turpentine, and Camphire never becomes a liquid oil: This butter is very emollient, anodyne, and relaxing, is good therefore in contracted members and pains of the hæmorrhoids.

P R O C E S S XXXVII.

The manner of turning butter of wax by repeated distillation from a retort into a liquid oil.

P R E P A R A T I O N.

Melt this butter, warm a glass retort, put it into it, taking care it stick not in the neck, fill it half full; join a recipient, give a gentle fire, so that the oil drop one drop in 6 seconds, encrease the fire gradually till all comes over liquid; rectification makes it more liquid.

Its

Its Uses.

The fire melts this butter and makes it milder ; it is good in chopp'd nipples, or any where in rigidities and contractions ; it lubricates the fœces, and externally helps children that way, and relaxes the papillæ nervosæ of the skin.

P R O C E S S XXXVIII.

Medicated Eleofacchara.

P R E P A R A T I O N.

1st, Physicians having found out that the spirit of the oil contains the whole virtue of the plant, they then begun to think how to blend them with water ; they took therefore the fine sugar and made an impalpable powder of it, to one ounce of this powder they gradually pour'd on a dram or a dram and half of essential oil, and rub'd them well together till all was dry. 2^{dly}, If you add a little yolk of an egg 'twill dissolve the better, but then it grows rancid. 3^{dly}, This, like soap, mixes easily with water ; neither need we fear the damage from sugar, which is balsamick and wholesome, being known to consist of oil and salt, and is easily to be converted into wine. 4^{thly}, This method is useful for conveying these oils entire in journies, when well stopt ; we may in the same manner mix them with an alkaline fixt salt, and they then make a soap, but their flavour is taken off ; if the eleofaccharum of Mint be put into Mint-water, adding a little of the spirit of Mint, sweetning the mixture with the syrup of Mint, we have the whole virtue of the Mint.

Its Uses.

Hence appears the saponaceous virtue of sugar fit for dividing the oils, which does not lessen the virtue of 'em; the ancients mix'd it with honey, having no sugar; sugar dissolves phlegm, does not encrease bile; by dividing the oils it may bring on a leanness, and by too great attenuation a debility; hence it is bad for rickets and scurvy. Sugar dissolves in water, melts in the fire, crystallizes, is fattish, affords an acid spirit, may be made into wine, and turn'd into vinegar: Is it a salt, why does it burn in the fire? Is it an oil, why does it crystallize? Is it an essential salt, why does it ferment? There is nothing like it in nature.

P R O C E S S XXXIX.

Diet-drinks from Process the 9th to 15, 18, 23, 31.

P R E P A R A T I O N.

1st, Take a dram of eleosaccharum, two drams of salt of *Tachenius*, mix 'em well in a mortar, then add six ounces of the distill'd water from whose oil you had made the eleosaccharum, mix a little of the syrup of the same, and you will have the collected virtue of that plant, the salt does not abate the virtue. 2^{dly}, If you know the virtue of the original plant, you have its virtues concentrated.

Its Uses.

The dose is to be regulated by the quantity of the oil, it must be given upon an empty stomach; in a tertian fever, two hours before the fit, let the patient bathe his feet and legs with a warm bath,
then

then every quarter of an hour throw in water of Wormwood thus impregnated, then rub their feet and legs very well, let these be continu'd till the two hours, you expected the fit, are past; and thus they are all cur'd, even in old age, unless there be a scirrhus or some impostume; thus, Tansy is good in the worms, manag'd in this manner.

P R O C E S S XL.

Scented balsams made from these distill'd oils, wax and pomatum.

P R E P A R A T I O N.

Take pomatum an ounce, mix upon the fire a dram of white wax, melt them, pour in a dram of essential oil, stirring them that they may be mixt, pour them into cold water, and put 'em into boxes; express'd oil of Nutmegs may be wash'd in water till 'tis white, and may be made with the oil in the same manner into a balsam: If we have a mind to make this balsam red, add Cochineel powder'd finely; if green, the juice of Buckthorn; if scarlet, Cinnabar; if yellow, Turmeric; if blue, Smalt.

Its Uses.

They are for the gratefulness of smell, and to excite the stupid; any aromatics, such as Oranges, Rhodium, Cinnamon, Mace, Nutmegs, &c. will serve the turn.

P R O C E S S XLI.

Any flower, even malt, distill'd, gives an insipid water.

P R E P A R A T I O N.

Take any flower, even of corrupted corn, as *Tacitus* calls malt, make it in a paste with water and distill, you get nothing spirituous from thence.

Its Uses.

Hence it appears there is nothing volatile in vegetables before fermentation; they afford a water that extinguishes fire, and that does not nourish (*m*).

P R O C E S S XLII.

Honey diluted with water and distill'd, affords a water smelling of honey only.

P R E P A R A T I O N.

Take fine honey one part, clear rain-water six parts, mix 'em well and distill from a glass retort on a moderate fire; the vapour arises, and drops not into streaks but water, altho' you should draw off two thirds; the smell is not winey but fragrant; throw this water upon the fire it extinguishes it, and taste it, 'tis insipid.

(*m*) *N.B.* All grain whatever will afford an acid and an oil before fermentation, and 'tis the fermentation that divides and attenuates this oil into spirit.

Its Uses.

Wherefore in this there is no such spirit afforded us by fermentation, nor does it attenuate or deterge; but mulsā, or honey and water, is attenuating, stimulant, and purging: This mulsā then is good in collyria, for inflam'd eyes; the same may be said of the decoction of Cassia, Manna, Sugar, and Tamarinds, which being mix'd with water and decocted, give no vinous spirits; the same may be said of fruits and other vegetables.

The history of fermentation.

The name of fermentation is of too general use, and 'tis taken for any change; *Bellini* complains that the chymists are too full of their ferments, and that *Helmont* attributes all to it. *First*, I understand by fermentation that change made by an intestine motion which produces inflammable spirits: Thus we limit fermentation, by it we understand such an intestine motion as is rais'd between the principles of any body; heat is requir'd in this affair, but there must be also an aptitude in the body to ferment, for none of 'em will ferment apart; this motion is only in plants, and is not found in animals, unless they have receiv'd vegetables into their fluids; 'tis never found in fossils: Fermentation terminates either into an inflammable spirit or an acid, wherefore nothing can be said to be fermented that does not produce these two effects; putrefaction makes oils and volatile salts, that intestine motion therefore which is found in animals produces not acids nor inflammable spirits, but phosphorical ones, therefore

fore different from fermentation; (*n*) nor is effervescence betwixt alcalis and acids to be call'd fermentation, tho' it be an intestine motion. *2dly*, This fermentation produces winey liquors, and they afford brandies and vinegars. *3dly*, Vegetables only are fermented with liquors, altho' all of 'em are not fermentable. *4thly*, 'Tis evident this ferment is only lodg'd in vegetables. *5thly*, There are various fermentable vegetables, and altho' all fermentable bodies can be putrefied, yet they cannot all be fermented; Onions and some others afford a volatile salt, but no brandy spirit: There are two classes of fermentables, the first are the seeds of plants that will powder, and these are divided into three sorts: 1. Culmiferous plants, those that bear grassy leaves and have ears, as all Corn, Linseed, Melons, and several others. 2. The seeds of leguminous, filiquose and papilinaceous, such as Broom, Mellilot, Fenugreek, Verches, &c. 3. Nuts not too oleous, as Almonds, Hazel-nuts, Walnuts, Cocoas, and Pistacios, which if they are too oily, they are first to be depriv'd of it by sprouting or the fire. *7thly*, The second class is where there is dulc-acid, as Cherries, Gooseberries, Mulberries, Elderberries, Raifins, &c. *8thly*, All succulent plants, so they taste acid, not acrimonious. *9thly*, The fourth class contains the juices of plants or fruits, as also of Birch, Walnut, and the Vine, for all these ferment of themselves: *Helmont* and *Boyle* commend the Juice of the Birch against the stone. *10thly*, The fifth class contains sweet things, as Honey, Manna, &c. *11thly*, I

(*n*) I ask this professor, How it comes to pass, that from the dregs of wine or beer distill'd, we can afterwards produce volatile salts and oils? Moreover, putrefaction and fermentation are both effects of an intestine motion; fermentation does not touch the volatile salts.

doubt

doubt whether river-water may be referr'd to this head; as to ditch-water, if 'tis included in hogs-heads that have contain'd fermented liquors, they may be in some measure fermented, as appears under the *Æquinoctial* (o). 12^{thly}, There are some physical conditions requir'd to fermentation, 1. The things to be fermented must be ripe. 2. They must not be too oily, but when they are macerated in water and left to sprout, then they lose much of their oil. 3. Aufteres and stypticks are unfit for this work. 4. They must easily be dissolv'd in water, therefore their juices are most easily fermented. 13^{thly}, The ferments are, 1. Those things which are apt of themselves to ferment, as ripe fruits and paste made with water of corn, &c. 2. The barm and froth of fermented liquors, if fresh. 3. This froth itself, when 'tis turn'd into a mass, will yet ferment. 4. Cassia, Manna, Honey, Sugar, and such inspissated juices. 5. The sour paste of corn, &c. this flower, if kept in a dry place and from insects, will keep uncorrupted for years; but if moisten'd with water and kept in a warm place, it ferments and proves a ferment. 6. The remains of liquors in hogs-heads. 7. The white of an egg beaten to water, which of itself is properly no ferment, but takes off the viscous impediments. 8. Some have referr'd hitherto acid, austere and alkaline salts; acids hinder the putrefaction, and alkalines, the acid; so that they are not properly ferments, but take off the impediments: Tartar, if good, is a ferment. 9. Austere bodies will serve as ferments, as Quinces and ripe Medlars, and sour Cherries; but these are only used when the spirits are apt to

(o) *N. B.* This opinion of the professor's destroys his own sentiments, for 'tis properly an oil produc'd by putrefaction, for no water will flame unless it first smells.

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fly off. 14^{thly}, We will now consider how to prepare bodies for fermentation; the things to be fermented are to be put into rain-water in large vessels in the summer time till they swell, this is call'd maceration. 2. They must be taken out and laid in great heaps in an open place till they begin to heat and sprout, but care must be taken that they do not putrefy, or bud into little roots. 3. The matter must be spread lest it grow too hot, and must be dried in a kiln; this is call'd malt: Thus the juices of the corn are attenuated and will easily melt, and have contracted a sweetness; then it must be ground, and all corn must be treated thus. See *Phil. Transf.* N^o. 142. and *le Febvre*. 15^{thly}, Those of the second class must be trodden or press'd, or reduc'd into pulp, or shav'd and beaten in water; thus are heated Grapes, Apples, and tuberosc roots. 16^{thly}, Those belonging to the third class must be beaten to the form of a pulse. 17^{thly}, The fourth and fifth class must be diluted with water till they will hold an egg; if they are too thick, they will not ferment, and the same happens if they are too thin. 18^{thly}, We must now consider the ferments, which are often useless in summer, but in winter they are requisite; for example, an ounce of Barm will suffice for 20 pound; Honey or Sugar will serve in the same proportion; the second class, unless in cold weather, requires no ferment, and then a little Barm will suffice; the third class also ferment of themselves, unless in winter, for then Sugar or Honey will serve the turn; the fourth class rarely requires any at all; the fifth class admits of none. 19^{thly}, All fermentables being thus prepar'd, and diluted well with water, put them into an oaken vessel where liquor has been fermented before, let them stand in a heat between 60 and 70°, leave the hogs-head open, or cover it with blankets. 20^{thly}, I
take

take glaſs cucurbites pretty large, I place them erect in a wooden cheſt, I place a ſmall fire at bottom ſo as to continue a heat between 60 and 70°, I fill theſe glaſſes 3 quarters full of fermentable matter, well prepar'd, I cover them with a cloth, even in winter, and you ſee how they ferment; 1. we ſee the matter ſwells and moves all ways, and is capable of burſting veſſels, and ſtrikes your noſtrils; 2. all the matter being under a continual agitation, crackling and bubbling, frames a cruſt at top of tenacious matter; 3. after all this commotion, the ſcæces ſettle and a cruſt remains quite at top and the liquor grows clear. 4. In the firſt degree of fermentation then, the matter is confus'd and the Barm riſes; in the ſecond there is a ſeparation into three parts, the Barm, the liquor, and dregs, in the laſt are the ſtrong liquor and the dregs. 5. The ſpirit of the liquor is ſo ſtrong, whilſt under fermentation, that it kills ſuddenly, and the ſame is ſaid of ſugar; *Phil. Tranſ.* inſomuch that vintners never enter their cellars without opening all their windows; what this ſpirit is we know not, but it unites to the liquor when the fermentation is over, hence ſpirit of wine is full of this ſpirit that kills. 21^{ſt}, The time requiſite for a perfect fermentation is determin'd by the ſeaſons; in *Africa* the Palm ſoon runs this courſe, in the north it proceeds ſlowly; when it has done working, keep the liquor upon its lees, and it grows ſtronger and clearer. 22^{dly}, This liquor is call'd wine, &c. every where, whoſe nature is to fuddle, chear, cauſe ſtupors, &c. and tho' Opium ſtupifies, it does not beſot; it warms and corroborates; the juice of fruits, barley, &c. eaten, do raiſe flatuſ's, &c. but fermented they cure the very diſorders rais'd by the former; new liquor of the vine unfermented raiſes dysenteries, but wine drawn into ſpirit helps them; no other liquor

liquor affords a brandy spirit till fermented, which yet will be diluted with water, which phosphorus when in flames does not. Tartar is the essential salt of wine, and peculiar to it alone; fermentation gives a brisk and *dolce-picquante* taste, which when unfermented is sweet; Aloes and Coloquintida fermented lose their bitterness; there is no difference between *French* brandy and spirits, so that its taste is new as well as virtues: The spirits of fermented things differ much; the *Spiritus Rectior* is lost in brandies, and oils do not mix with water as brandies do; Rosemary fermented half way and distill'd, gives out some oil, but if quite fermented and distill'd, all the oil is gone, so that fermentation takes away the essential oil; this essential oil becomes by fermentation more volatile than water. (p) The following conditions are requir'd for fermentation: 1. It must be so quick as not to break the crust at top; 2. a free admission of air; 3. a warmth between 60 and 80 degrees; 4. spring and fall. 24^{thly}, Hence the following circumstances hinder it: 1. Any acid in steam or liquor; 2. any alcali put into it in a large quantity, it makes all huff up, but then the liquor putrefies, but ferments no more; 3. hence Chalk, Iron, Tin, Lead, &c. hinder it; 4. stopping up the hogsheads too soon; 5. cold of 30 degrees; 6. heat above 90 degrees, it inspissates the liquor, so boiling the juice of grapes hinders it and renders it unfit ever to ferment; 7. drawing off the elastick air by the air-pump; compression stops it presently. 25^{thly}, If you design to get brandy from the fermented liquor, let it not be

(p) The essential oil by fermentation loses its cohesion, and unites with water; hence is there a greater attrition made use of by such an agitation, than by any other method.

done

done just after fermentation, for fear of Expansion ; and mix the settlings along with the liquor by boiling it and stirring, and then you get stronger spirit, and without danger of Empyreuma. 26^{thly}, To prevent burning or Empyreuma, 1. anoint the still with some fatty substance ; 2. shake all well together before you put it into the still ; 3. boil some water in the still before you put in your liquor, and this hinders any thing from sticking. 27^{thly}, By jumbling all together, you get good spirits. (q) 28^{thly}, Take care of the first force of the liquor's boiling, by leaving one 3d of the pot empty, and by covering the neck of the pot with a thin cloth clapping on the alembick. 29^{thly}, The first of the liquor is hot, volatile, flames, fuddles, besots, heals the nerves and tendons, preserves from putrefaction, when it is not quite alcohol but sweeten'd with sugar, it keeps things tender, if mix'd with water and vinegar ; 'tis an excellent discutient in gangrenes, &c. dissolves coagulations, &c. 30^{thly}, Next comes up an acid water, and dregs remain at bottom thick, and affording an empyreumatick oil. 31st, And being burnt affords a subalcaline salt ; hence fermentation can't make all parts volatile. 32^{dly}, Behold, most worthy hearers, the whole history of fermentation in all its circumstances, let us no longer confound fermentation with any other operation ; thus we shall no longer confound the action on animals and fossils with this ; fermentation is begun indeed in the stomach and guts, but breaks off there and putrefaction ensues ; hence let us distinguish for the future between effervescences, ebullitions and putrefactions. (r)

(q) See Caution 2d of 26.

(r) They are both species of intestine motion, which word includes them both ; fermentation is an intestine motion rais'd between the oils and the acids, and putrefaction between salts.

PROCESS XLIII.

Meal and Malt moisten'd with water enough do ferment.

PREPARATION.

We will now give examples of fermented liquors: There are two methods of making beer and its spirit; the first is thus: Take ground malt, pour upon it boiling water, let them infuse, then draw it off, boil it to a thickness, which is call'd *wort*, 'tis sweet and relaxing, boil some bitter herbs in it, then add Barm and work it, 'tis Ale and Beer; distill it, you get a spirit: This *Diodorus Siculus*, l. 1. knew; this *Herodotus* calls *fermented wine from brandy*; *Tacitus* also speaks of it, *Aetius* calls it *Byne*. The common way is, Take ground malt ℥xxiv. Rye-meal ℥vij. steep them in water that boils, put them into a barrel, keep it warm, they ferment, leave them till they have done, fermenting, shut the barrel, the liquor will be clear.

PROCESS XLIV.

Honey diluted with water ferments.

PREPARATION.

Take honey, dilute it with such a quantity of water as an egg will swim upon it, 'tis call'd *mulsa*, fill a hogshhead with it standing upright with a hole on the side to draw the liquor out, put this hogshhead into a wooden case in 70 degrees of heat, it begins to ferment, and makes at last mead.

PRO-

PROCESS XLV.

Malt and meal fermented distill into spirits and vinegar.

PREPARATION.

Pour into the distilling pot a pint of boiling water, upon which pour in the fermented liquor of the 43d Process well shaken together, leave one 3d of the pot empty, kindle the fire under it and stir the liquor well about, when 'tis near boiling clap on the alembick and distill so long as brandy comes ; but as soon as the liquor becomes white, the acid spirit comes forth.

Its Uses.

This first spirit is the fermented one.

PROCESS XLVI.

Mead produced by fermentation distills into brandy, vinegar.

PREPARATION.

Put the mead well fermented into the pot with all the foregoing cautions ; the first spirit that comes is the brandy, the next is the acid white spirit.

Its Uses.

Thus we gain brandies and an acid spirit, what remains at the bottom of the pot will never ferment again, but turns acid.

P R O C E S S XLVII.

Depuration of the spirituous liquors got from fermented bodies.

P R E P A R A T I O N.

Take any spirit, fill the pot two 3ds full, clap on the alembick and distill; it must often be tasted to know the strength of it, the strongest comes first, and the acid water last; and a thick acid humour remains at the bottom, which is red from red wine.

Its Use.

The oftner we distill the more pure is the alcohol; spirit of wine contains brandy spirits, water, and an acid, which may be separated by the 49th Process; hence the effects from common spirits are such as are not much to be ascrib'd to the spirit of wine, we cannot affirm that these spirits are either alkaline or acid; however, let us distill ever so much 'tis a compound body.

P R O C E S S XLVIII.

Alcohol from fermented spirits without any addition.

P R E P A R A T I O N.

Any fermented spirit distill'd in 100 degrees of heat from a high streight-necked glass cucurbit by a gentle fire to one half; distill this half again, so often that what remains is as strong as what you call off; this is true alcohol, however the strongest alcohol has some water in it; moderns

derms have found another way of distilling it : put spirit of wine into a distilling pot two 3ds full, place this in boiling water, clap on the alembick with a worm to it and distill, thus the spirit will distill without the water : See the description of this furnace among the figures, however some water comes up this way ; redistilling of this makes it as pure as it can be, for still there is water in the spirit not to be separated from it. I try'd this distillation in the following manner : I fill'd the pot half full with alcohol of the first distillation, I added to it half a pound of decrepitated salt, I clapt on the alembick and luted it well, and left 'em for 12 hours in so small a heat that they could not boil, then I distill'd two ounces and kept it apart, lest there should be any water sticking to the sides of the worm, then I force up the remainder ; the salt remaineth at bottom, and does not spoil the spirit.

Its Uses.

This alcohol is a fine liquor, lighter than any body but air, flames all away without smoke or dregs, never is chang'd by re-distilling, it coagulates animal juices in a moment, and hardens the solids, preserves bodies from putrefaction, and will keep for ages ; it mixes with any liquors, dissolves gummosse bodies and extracts tinctures from thence, and is owing to fermentation ; it refreshes the spirits, but excites drunkenness ; outwardly it corroborates, and dries and contracts ; hence alone 'tis not proper for fomentations without Camphire, &c. because 'tis so caustick and drying ; and if it is us'd to nerves lacerated or punctur'd, it eases their irritations by proving caustick : It stops bleeding in a moment, it preserves bodies put into it from putrefaction : That we may know pure alcohol ; first, if any oily bodies

dies are contain'd in it, it grows milky in water; if any acid be in it, spirit of salt Armoniac will effervesce with it; if any alcali be in it, acids will ferment with it; and to try whether there be any water in it, we kindle it, if it all evaporates, there is no water, or if it fires gunpowder; or take a chymical glass, with four or six ounces of alcohol, put dry salt of Tartar to it, a dram gently warm, if the salt of Tartar is not wet, there is no water; but this seldom happens: We can go no further with fermentation than to produce alcohol.

PROCESS XLIX.

The making alcohol with alcali's.

PREPARATION.

Put common spirit of wine into a glass cucurbit, mixing with it one 3d of pot-ashes, shake the glass and the liquor swims red at top, and the salt is moist at bottom; the more you shake, the moister the salt grows. Let them stand and settle, put in more salt, do as before; repeat this in a heat of 100° till the salt remains dry at bottom; the liquor is red, and effervesces with acids; the salt becomes of the taste of *Terra foliata Tartari*, and 'tis remarkable that an oily substance comes either from the spirit or salt, or both.

Distill this so prepar'd, and you get a clear pure alcohol, especially if you drop in as much oil of Vitriol as till it ceases from effervescing.

It is then hard to acquire pure alcohol, for tho' the alcali takes off the water, acid and oil, yet it leaves it salt.

This is the utmost purity that we can bring alcohol to; it never changes by any further artifice;

tifice; this is the *Samech Paracelsi*; for the rest, we shall speak of it in the 80th Process.

PROCESS L.

The origin of vinegar.

Having consider'd alcohol, let us now consider how vinegar is made. To make vinegar, wine must first be made; if fermentation be carried too far, the wine turns sour, but it must be put into a hoghead that has had vinegar in it: All wine is apt to turn into vinegar, the stronger the wine the better the vinegar; the best ferments are first the dregs of sour wine, or of vinegar, or the tartar of some wine reduc'd into powder, or vinegar it self pretty tart, or hogheads that have held vinegar in them, or the frequent repetition of the dregs put into that hoghead, or the stalks or skins of Cherries and such sour plants, or leven, or all these compounded together.

Glauber describ'd this history heretofore, which has since been communicated to the Royal Society, which I shall here repeat to you: You take two hogheads, in each of which you make a grate a foot high from the bottom, upon this grate you place vine-twigs up to the top, you put wine above these so as to fill the one full and the other half full, you fill that which is half full with the liquor of that which is full; you keep 'em upon a moderate heat, and thus you change alternately, they ferment and the liquor grows sour; the warmer the weather, the quicker is the fermentation; the stronger the wine, the better is the vinegar; beer vinegar is as good as wine vinegar (s). See *Phil. Transact.*

(s) The professor's taste is extremely bad, to recommend beer vinegar to be as good as wine vinegar.

Vinegar then is an acid oleous liquor, that extinguishes fire; the spirit from wine flames, the vinegar from wine extinguishes; 'tis said that vinegar is the tartar of wine. As to its nature, I shall observe the following things; 1st, 'Tis a volatile oily acid that resists putrefaction, and is very penetrating and mixes with all the humours of our bodies, not oil excepted: 'Tis good in bilious fevers, and quenches the thirst arising from venomous bites; it was used by the ancients mixt with honey, and then was call'd *Posca* or *Oxycrate*. Surgeons use it for erysipelas's, phlegmons and putrid ulcers; and 'tis efficacious in the hydrophobia: It checks drunkenness, helps lethargick people, and quells vomitings, and is good in synopes and in convulsions; in hypochondriac and hysteric people, as also in gangrenes, as it preserves from putrefaction; nay, it has an attenuating power, let others think what they please, this I affirm; for if it be mixt with the serum warm, it dissolves coagulations, and is excellent good in the small-pox and meazles, plague and ardent fevers; and is an excellent remedy to dissolve the coagulations produc'd by such diseases, where volatile salts are given with great danger (*u*). *Sylvius* relied upon it against the plague; we do not know a better sudorifick in pestilential cases; 'tis a mixture of acid and the brandy spirit; the spirit of wine is converted into the nature of the vinegar (*x*); perhaps it is the tartar of the wine join'd to a little oil; in the distillation of wine the spirit comes first, but in the distillation of vi-

(*t*) This were an excessive ignorance to recommend vinegar in a stagnation; which, as I have experienc'd, a rabies produces!

(*u*) I have never heard of such paradoxes in practice in my whole life.

(*x*) Therefore transmutation is possible.

negar

negar the water comes first: We see then the preparation of this four from the sweet of wine; warmth, free air, motion and mixture of aromatics, help the production of vinegar; and all those things which hinder fermentation, except motion, do hinder the production of vinegar (y).

PROCESS LI.

The distillation of vinegar into an acid water, an acid spirit, an extract, tartar, and an oil.

PREPARATION.

Put vinegar into a glass cucurbit three quarters full, distill gently till one 4th part comes over; this is gently acid, and *Vigani* tells us, that the first that comes over is brandy, and upon trial I have found it so with *French* vinegar, viz. it was like common brandy join'd to a little acid; but when this vinegar was old, it was not so, the spirit was gone off; what remain'd I distill'd off to two 3ds more, the liquor was still more acid, and was truly spirit of vinegar, and the one 4th that remain'd in the still requir'd a greater fire, and was very acid; what remain'd at the bottom of the retort afforded by a very strong fire a very ponderous fetid acid, and at length an oil; the remainder being burnt, gave a fixt salt: From whence it appears there is no alcohol in vinegar, nor any tartar, and it differs from all acids whatever: For common use we distill it from a brass pot tinn'd; the first 4th part we keep apart, the other two 3ds remaining we draw off for spirit of

(y) This author does not know what to say of vinegar; this reminds me of what is said in the *Journal des Scavans*, *Voilà une certaine Rhétorique Pedantesque qui consiste à parler beaucoup et à ne rien dire.*

vinegar, and the last part left behind we keep for the strongest spirit.

Its Uses.

Its uses are the same, but stronger than those of vinegar; the magma left at bottom after seven 8ths are drawn off, is an excellent remedy against putrefaction, 'tis of a soapy nature: Who wou'd believe so much oil is in vinegar, or that a soapy substance shou'd be got at bottom, or that it wou'd make lead into a sugar, or that this sugar of lead wou'd afford brandy, unless you say that lead is combustible? but vitriol of lead prepar'd with spirit of nitre affords no brandy; distill'd vinegar put to salt of tartar, the acid and the salt unite and leave a brandy, as in Process 76, and 'tis strange that an acid shou'd afford an alcali.

P R O C E S S LII.

The Rectification of distill'd vinegar by itself.

P R E P A R A T I O N.

Take the distill'd vinegar of the last Process, put it into a glass cucurbit and distill it to half, that which comes over is not very acid, that which remains in the cucurbit is the strongest.

Its Uses.

In the distillation of wine the strong spirit comes first, but in vinegar the weak; hence boiling makes wine vapid, but vinegar stronger; vinegar by boiling flesh, cartilages, bones and skins in it, reduces them to a thick liquid; metals require the strongest.

P R O-

PROCESS LIII.

The rectification of spirit of vinegar with verdigrease.

PREPARATION.

Pour upon verdigrease rectified distill'd vinegar to 10 inches high, place 'em over a fire of 150° in a glass cucurbit, stir them well together, the vinegar will be died green; pour this out and put in more, and thus continue to do whilst the verdigrease tinctures the vinegar. *N.B.* Verdigrease is only the rust of copper produc'd by the raisins press'd. Filter all these liquors, and distill them in 200° of fire from a glass cucurbit till a pellicule appears at top; the first liquor that comes off is but little acid, and the remainder being plac'd in a cellar, you gather the crystals; the remaining liquor must again be evaporated to a pellicule and then you gather more crystals, and thus you proceed till you have gather'd all; this is call'd distill'd verdigrease, 'tis an escharotick; you take these crystals and distill, the first that comes over is weak, but the last is a very strong acid, and is call'd by *Zwelfer Acetum Esurinum*.

Its Uses.

This is the strongest fermented acid, and restores the appetite in bilious constitutions, but is bad in acid ones; absorbents take off its force; distill'd vinegar is an acid and water, verdigrease licks up the acid and leaves the water behind; this acid joins with the copper into a solid, but being call'd off, it leaves the copper in powder unchang'd; this in dissolving lead and iron does not happen, for from them, as well as from fixt salts
or

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or volatiles, we can recover no vinegar; so that copper is the only one that returns it (z).

P R O C E S S L I V.

The production of tartar from wine.

P R E P A R A T I O N.

This tartar is produc'd after the wine has been thoroughly fermented and stood; such is the colour of the vine, such is the tartar; see the 8th Process. This tartar does not dissolve in wine, or in water, but in boiling water 'tis dissolv'd into cream of tartar, which swims as a pellicule at top, and is gradually taken off with a spoon with holes in it; or if you boil tartar in 20 times its quantity of water till 'tis dissolv'd, and pour it into a wooden vessel, it grows into crystals; this salt is different from all others.

Its Uses.

The 8th Process and this illustrate the nature of fermentation and its product, viz. Tartar: diers, goldsmiths, chymists, and physicians use it much; this cream is gently purgative.

(z) This is a great mistake, for from all bodies whatever we can again recover the vinegar by a strong fire: The stronger are the bodies, the harder it is to recover any acid; but it is recoverable, which is what the professor denies: So far will men run to favour an *Hypothesis*.

P R O-

P R O C E S S L V.

Tartar resolv'd by distillation into water, acid, spirit, oil, and fixt salt.

P R E P A R A T I O N.

Put white tartar broke into little pieces into a glass retort so that one 3d remain empty, place it on a sand furnace, fit to it a large recipient, lute with Linseed, flower and water, put under it a fire of 100° , and you will first get an acid water that will penetrate through the lute, keep this apart; increase the fire to 212° , the white vapour that comes up, sweats through the lute, and if you had made use of a stronger lute, it would break the recipient: Along with this spirit comes up a yellow oil which sweats through any lute, nor cou'd I ever hinder it: This oil is good in contractions of the membranes or tendons. These being taken away, lute the recipient again, you gain more spirit and a black stinking oil, and at bottom remains the black tartar, which heats as soon as expos'd to the air, and by being calcin'd becomes salt of tartar, that melts in the open air, and is alkaline.

Its Uses.

Fermentation therefore produces strange things, first, a subtle liquor call'd wine, then a stone not dissolvable in water, which produces the various things in this Process; one would wonder where all these things lay hid, or how the fire should turn it into an alkaline; re-affuse these liquors to the black tartar, you regain nothing but a little oil; the first oil is very penetrating and discutient, and good against contractions; and when rectified,

'tis

'tis commended against gouty nodes: Some say it returns decay'd flavours, as a jakes does that of Musk and Civet; this fixt salt is most plentifully found in tartar, and 'tis the strongest of them all; this black tartar expos'd to the air makes an oil of tartar *per deliquium*.

P R O C E S S LVI.

The tincture of gum lacca by 12, 55, 47, 48, 49.

P R E P A R A T I O N.

Beat gum lac to powder, moisten it with oil of tartar in an urinal, dry this gently in the first furnace, then expose it to the air till it run, dry it again, thus do often over; then pour in alcohol to four fingers height, stopping the glass with a paper plug, put it on the same furnace till it nearly boils, let the liquor cool, pour it off, pour on more spirit of wine, this repeat till it affords no more tincture, let them subside, then distill off half the spirit of wine, keep the tincture.

Its Uses.

Hence this hard body is dissolv'd, and thus we gain all tinctures; it heats and exagitates the nerves and spirits, resists putrefaction and constricts the vessels; hence is this tincture good in the scurvy of the gums, and internally may be given in cold distempers, as scurvy, gout, rheumatism and dropfy, and in the *fluor albus* thrice a day in *Spanish* wine.

PROCESS LVII.

Tincture of myrrh after the same manner.

PREPARATION.

Proceed as in the last process.

Its Uses.

'Tis good in ulcers, because it deterges; 'tis good for embalming; 'tis useful in all cold watry diseases and relax'd fibres, as also in the *fluor albus*.

PROCESS LVIII.

Tincture of amber in the same manner.

PREPARATION.

Powder amber, then add oil of tartar, beat it into a pulp, pour on spirit of wine, and in all things proceed as in the tincture of lac.

Its Uses.

The composition of amber seems to be petroleum and an acid; 'tis neither alkaline nor acid; 'tis bitter and aromack, and somewhat astringent: In winter the tincture deposits a resinous matter, which heat dissolves; it totally almost dissolves in spirit of wine; 'tis a good antihysterick, good in cold and watry diseases; 'tis antiepileptick and anticonvulsive; the tincture has more virtues in it than the amber itself (a).

(a) *Quid potest dare, quod non habet?*

P R O-

PROCESS LIX.

Tincture of benjamin by 47, 48, 49.

PREPARATION.

Take benjamin, powder it, pour on spirit of wine, boil them, repeat this once or twice, and the tincture is made.

Its Uses.

If this be put into water it grows milky, and is fit for washing the face, as barbers know.

PROCESS LX.

Tincture of guaiacum by 47, 48, 49.

PREPARATION.

Take guaiacum in powder or its bark, pour on spirit of wine in a chymical glass with a long neck, boil them together; this you may repeat as often as it affords a tincture; strain the tincture from the fæces, distill off the spirit of wine to one 4th, if the spirit of wine should be watry, the resin will subside.

Its Use.

This and other tinctures of resinous bodies serve to make resins; sanders, rhodium, and the like, may be made tinctures of after the same manner. This tincture is good to wash venereal ulcers withal.

P R O-

PROCESS LXI.

Tincture of Scammony by 47, 48, 49.

PREPARATION.

This, tythimal, euphorbium, dandelion, tragopogon, and such as afford milky juices, are all made into tinctures with spirit of wine, as in the 47th, 48th and 49th Process.

Its Uses.

It purges, to wit, $\mathfrak{z}\text{ij}$ with $\mathfrak{z}\text{j}$ of syrup of Roses; hence it is plain, that spirit of wine dissolves its like: If a saponaceous body is to be made into tinctures, then common spirit is best, as hellebore, jalap, mechoacan, &c. so tincture of jalap with much rectified alcohol, purges not so well; so Opium is best in wine, water and common spirit will do, but not so well; alkaline salt does not always answer for some tinctures.

PROCESS LXII.

A purging potion from 61, a sudorifick from 60.

PREPARATION.

Take tincture of scammony $\mathfrak{z}\text{ij}$, syrup of rheubarb (of rheubarb with succory, of roses or of fenna) $\mathfrak{z}\text{vj}$: Or take tincture of jalap $\mathfrak{z}\text{iv}$, syrup of buckthorn $\mathfrak{z}\text{ss}$. They will purge.

Take tincture of guaiacum $\mathfrak{z}\text{iv}$, syrup of the opening roots or mugwort $\mathfrak{z}\text{ij}$, mix, it sweats, and is good in the pox, taken fasting. Tincture of *Lign. Colubrinum*, is good in intermittents.

Its Uses.

These tinctures are apt to stick in the bowels ; with water they precipitate, nor can they be taken alone ; hence syrup is their best vehicle.

P R O C E S S L X I I I.

Virgins milk, from 59.

P R E P A R A T I O N.

Pour tincture of benjamin into water, and it grows milky.

Its Uses.

This shews how resins are made ; the resinous particles and fleaks unite, and become resins.

P R O C E S S L X I V.

Resins from 60, 61.

P R E P A R A T I O N.

Put the tinctures of the 60th and 61st Processes into water, and the water grows white and the resin falls, which may be gather'd, and the spirit may be recover'd by distillation. As soon as the resin hardens, gather it ; it melts by heat, dissolves in oil or alcohol ; keep it dry and shut ; camphire and benjamin are natural resins. *N. B.* When pure alcohol acts on plants, its action is as if it were common brandy, because the plants are also watry.

Their

Their Uses.

There is reason to doubt whether resins are oils thicken'd by acids. These resins are caustick and are apt to stick; hence the yolk of an egg or syrup must be us'd to dissolve them, otherwise they are apt to go down in pills undissolv'd. Oils grow resinous if they are depriv'd of the spirit or alcohol they were dissolv'd in; thus oil of cinnamon dissolv'd in alcohol, call off the spirit, and with water the oil grows resinous and white. The purgative quality resides in the resins; but also in the extract, for dissolve this extract in water, boil, you have a purgative.

PROCESS LXV.

Essential extracts of saffron by 48.

PREPARATION.

The ancients call'd saffron the *aroma Philosophorum*; it contains volatile parts, and is easily corrupted.

Take *English* saffron cut small two ounces, put it into a glass; pour spirit of wine upon it to six fingers height, stop the glass with a paper cone, give heat of 100° under ashes, you get yellow tincture; the saffron grows pale; pour out the alcohol and pour in more, till you get all the tincture; pour on water at last, and you make the saffron white, 'tis then a wonder where all this tinging matter lodg'd.

Distill, you get a spirit smelling of saffron, and the remainder keep, 'tis a rich tincture.

Their Uses.

This experiment shews us an oleous spirit, neither resinous, gummosse, oil, spirit, nor balsam: Its extract mixes with water, oil, and spirit; it is of such a quality, as to make those who take it laugh immoderately; it dyes the urine yellow or red; it is lithontriptick; this preparation is preferable to that of letting it corrupt in a dunghill; it has virtues not to be accounted for.

Ambergrease, mosch, civet, castor, &c. afford tinctures like this, by the same method.

Extracts may be made so as to contain the whole virtue of the drugs.

P R O C E S S LXVI.

Essential extracts of camphire by 48, 49.

P R E P A R A T I O N.

Camphire comes from *Ceylon*; they distill the root of its tree and that affords an oil, this they sublime again and it grows resinous; this mix'd with spirit of wine dissolves in it, and rises with it if distill'd together, but grows milky with water, and if dissolv'd in acid spirits, it also turns milky in water.

Thus dissolv'd it is discutient and good in gangrenes, is drying, promotes perspiration, but I fear 'tis not good in nerves that are hurt.

PROCESS LXVII.

Quintessences from 23, 30, 48, 49.

PREPARATION.

1st, Put any essential oil with 12 times its quantity of the most rectified alcohol alcaliz'd, shake them together and they make an uniform mixture clear and limpid. 2^{dly}, It appears that essential oils will mix with this rectified spirit, but if any water be join'd, it then turns white. 3^{dly}, Distill this mixture, and the oil and spirit unite the better. 4^{thly}, If you distill with a fire of 90°, the alcohol will ascend impregnated with the spirit of the oil, but not the oil itself, which remains thick at bottom.

Their Uses.

These are call'd quintessences, because there is somewhat added besides the four elements; one drop of this essence dropt into *Spanish* wine, is a great refresher of the spirits; if one drop of this mixture be put into water, it grows milky; and thus we discover oils being mixt with alcohol, alcohol then acts upon the spirits and oils of plants, and unites with 'em: These quintessences resemble fire, and being imprudently taken, or applied outwardly, they produce inflammations, and even gangrenes.

P R O C E S S LXVIII.

Dry quintessences prepar'd with sugar from 67, 65.

P R E P A R A T I O N.

First, Take alcohol dissolv'd with aromatick oil, pour on 10 times its quantity of fine sugar, mix 'em well together in a mortar, put the mixture into a purcelan vessel within a glass cucurbit moderately warm, that the remaining spirit may extract, and by putting on an alembick may be gather'd into a liquid quintessence; in the purcelan vessel the quintessence will impregnate the sugar; this also may be done with a dram of wheat flower and five drams of white sugar; the same may be done with a dram of quintessence of 67, half a dram of essential extract of 65, and three drams of sugar and as much wheat flower; there are infinite manners of making these quintessences.

Their Uses.

→ We see what pretty tricks we play with remedies, and collecting the virtues of 'em summarily, for if a scruple of this be mixt with an ounce of *Spanish* wine, it proves a great aromatick; chymistry then affords the best of remedies; the convenience of these quintessences is that they may be carried to a distance.

P R O-

P R O C E S S L X I X.

A simple aromattick spirit from the flowers of lavender.

P R E P A R A T I O N.

Take six ounces of fresh ripe lavender flowers, gather'd after mid-day in fair weather, common spirit of wine 12 pound, distill according to art till a white liquor appears; for first the clear liquor comes, which is the spirit, then the white liquor which is the water; keep both apart, at bottom the liquor is brownish black; then take three ounces of fresh flowers, pour both these liquors upon them; distill the spirit off, which is call'd the double spirit of lavender; you may, if you please, pour on two pound of water to the white water, and distill one pound from thence.

You may repeat this operation over again with the spirit and the water, and it will still be richer; the same may be said of all aromattick flowers, such as Gilliflowers, Rosemary, &c. The Queen of Hungary's water is such a spirit of Rosemary flowers.

Its Uses.

The oil mixes well enough with the spirit, but it makes the water white; the virtues of these spirits resemble the quintessences of 67, and grow milky in water as they do.

P R O C E S S LXX:

A simple aromatick spirit of the dry leaves of Mint.

P R E P A R A T I O N.

Take dry Mint leaves, pour 20 times their quantity of brandy, distill to half; this is the spirit of Mint; if you press out the remainder, add more Mint, put to them the first spirit and distill to half; repeat this a third time, and you get spirit of Mint three times cohobated.

Its Uses.

It is good in cold, sour, phlegmatick, watry, windy stomachs, to half an ounce, and in vomiting.

P R O C E S S LXXI.

A simple aromatick spirit of Rosemary, or any spices and aromaticks.

P R E P A R A T I O N.

Take Rosemary-tops, fill the glass half full, pour on brandy till the vessel is two 3ds full, distill to half, and proceed in every thing as in 70; let this be done in any wooden furnace: If we distill this spirit oftner than thrice, the spirit becomes ungrateful, and smells like fresh wax.

Its Uses.

This spirit is not distinguishable from that of the flowers (Process 69.) and it has the same virtues. So is distill'd the spirit of lavender, &c.

P R O

PROCESS LXXII.

A compound aromatick spirit.

PREPARATION.

The *Spiritus Rectior* may be in the waters, in the oils, and in both united; I made the following for *Sal volatile oleosum*; Take orange, cinnamon, lemon, bark of each four ounces; flowers of orange, citron, lemons, lavender, red Roses, Rosemary, of each two ounces; roots of Angelica, *Florentine* orris, of each one ounce; cloves, mace, nutmegs, of each two drams; rectified spirit of wine, 15 pound; distill according to art, so long as clear spirit comes over, which keep apart; then distill two pound of the white water, which call an aromatick water. Take fresh ingredients, and distill a second time, as in Process 70, &c. when you repeat the operation another time, hang Ambergrease in the beak of the cucurbit. My wooden furnace may be us'd, or a retort, with a slow fire.

Its Uses.

See Process 69, 70, 71, and we learn the use of this spirit; they recruit our spirits in old age, but their effect soon vanishes, so that the first dram soon demands a second.

P R O-

P R O C E S S LXXIII.

Soap made of exprefs'd oils and a fix'd alcali (13.)

P R E P A R A T I O N.

Take equal quantities of oil olives and oil of Tartar, mix them, they grow milky, but in time they part, and the oil Olive swims; the reason of their union is the acid of the Olive oil, for oils without acid unite not so well: Boil these gently together till the water in each of them flies off, and this is *soap*. The stronger is the alcali, the better is the soap; hence lime is most in use, whose quantity use has taught; they take the alkaline salt of Process 13; they boil it in water till the liquor bears an egg; then they take part of this *Mistress as they call it*, and dilute it with more water, until an egg will fall to the bottom; they take the fresh oil and mix it with this weaker lye; they boil these together, stirring, till they begin to unite together, then they pour on the stronger, or mistress, three parts to one share of oil, and boil, till a drop on a stone hardens, and try'd with water lathers, for if any oil appears on the stone or in the water, they add more of the strong lye; if it taste too acrimonious, they add more oil and boil on, till by trial it will cut when cool'd. In the place of oil Olives, any fats of fishes or animals will do; and whale oil serves for black soap; and the purer the alcali and oil are, the better is the soap.

The Uses.

We learn from hence how oils and fixt salts will unite; oil by alcali loses its nature; where oils abound in us, salts are wanting; hence then fixt
 salts

salts are good; oils we see obtund alcali's, and are therefore good in acrimonious blood, as appears in acute cases, scurvy, pains of the kidneys or bladder; salts dissolve gums and gummose bodies and coagulations, they deterge as soap does; they disengage adhesions and prevent strong concretions; it is anti-acid, and dissolves humours; in ulcers it is good to inject; it may be ting'd with saffron, turmerick, cochineal; its nauseous smell may be abated with any balsam of *Peru*, &c. but its use is bad in putrefactive diseases, as plague, &c. it does what water or oil can't; it is better than alcali alone.

P R O C E S S LXXIV.

Soap from distill'd oil and a fixt alcali (12.)

P R E P A R A T I O N.

This has been much desir'd heretofore; 'tis done thus, pour upon hot and scalding fixt salt, the æthereal oil of turpentine drop by drop, stirring well, till you have pour'd on enough; put it then into an urinal and cover it, and place it in a cellar. The salt that rises up into the urinal is not volatile, as I try'd by subliming, for nothing ascended.

Its Uses.

It is saponaceous, and acts, but more powerfully, as the former. This is *Matthew's* soap for *Pihule Mathæi* or *Starkeianæ*. It is chang'd with acids; it makes with alcohol the *Elixir parvum sapientum*.

P R O

PROCESS LXXV.

Tartar tartaris'd.

PREPARATION.

Take tartar, powder it, boil it in water till it is clear; whilst it boils pour in oil of tartar gradually, thus continue to do so long as there is any ebullition rais'd by pouring in the oil; then take it off the fire, strain it, then evaporate, and you get this *Tartarus Tartarizatus* or *Solubilis*.

Its Uses.

Thus you get tartar soluble in water, neither acid nor alcali, but a neutral salt; tartar, which is a stone, and very hardly soluble in water, by pouring in the oil of tartar they make a new kind of salt which is purgative, and may be the *Samech* of *Paracelsus*; 'tis an excellent remedy for the dissolution of viscous parts, as appears by its dissolving lacca and myrrh, it expels the viscous matter by urine; 'tis good in the stone, jaundice, and spleen; and when cream of tartar is taken inwardly, the salt of the bile joins in with it, and makes it a salt like this.

PROCESS LXXVI.

Tartar regenerated.

PREPARATION.

Pour on to a strong fixt salt, distill'd vinegar, so as to cover it; at first there is no fermentation, but by concussion a great one arises, which is very strong and lasts a long time; the salt requires

quires 14 times its weight of the spirit; when we have sated the salt so that they effervesce no more, then this is a new salt, which is diuretick, diaphoretick, and purgative, and which attenuates, given in a proper dose; distill this and you get a pure water, there remains at bottom a penetrating liquor; if to this remainder we pour on more spirit and they should effervesce, we must saturate the salt till it ceases fermenting, then we evaporate till all is dry, and this is call'd regenerated tartar. *Homburg* found that the alcali was one 29th of the acid, and that the water was 36 of the whole: If we encrease the fire to any great degree, it flies off, but by a gentle fire it turns into a mass that will cut like chalk; in the cold it appears in this form, but with heat it runs like oil.

Its Uses.

By this we observe the following particulars; that this acid and alcali effervesce; that they melt into oil by the fire because they flame; by distillation they afford an oil, and they appear like oil on the fire; that a new salt is generated by the mixture of alcali and acid; that we can ascertain what acid and what water is in vinegar; how to convert a strong alcali into a saponaceous body; how to obtain an excellent menstruum; how to gain a remedy that profits cold distempers, and hurts not hot ones; is not this the *Sal Tartari volatilis* of *Helmont*, which was a succedaneum for an alcaest? is not this the *Acetum radicum* of the chymists? if you dry it too much it will fly off.

PROCESS LXXVII.

A tincture of tartar tartarised.

PREPARATION.

Take tartar tartaris'd reduced into fine powder; pour on alcohol to four inches height, put 'em into a viol stoppt with paper; let 'em boil gently for the space of a night and a day; the alcohol will turn of a golden colour, a fine aromack, tart, penetrating and warm; you may repeat this with new alcohol, and there will be a fine salt at bottom.

Its Uses.

This shews how much of this salt will be dissolv'd in alcohol; 'tis warming, cleansing in ulcers, and consolidating in wounds, and the salt at bottom is white.

PROCESS LXXVIII.

A solution of tartar regenerated in alcohol.

PREPARATION.

Pour on to tartar regenerated six times its quantity of alcohol, boil it gently in our wooden furnace and 'twill be an equal composition, the dregs subsiding; decant the liquor, if any salt is undissolv'd, proceed as now said with more alcohol, decant; then distill to half, and you have the tincture.

Its

Its Uses.

Here's an union of alcali, acid, and an oily spirit, free from earth and any dangerous acrimony; this is the *Elixir parvum sapientum*, which is very penetrating and diaphoretick, a great dissolver, is good in wounds, ulcers and tumors; 'tis easily prepar'd by mixing pot-ashes with 15 times its quantity of vinegar; then strain and inspissate. *Pliny* knew this, when he commanded the ashes of vine twigs to be mix'd with vinegar against the spleen diseases.

P R O C E S S LXXIX.

Harvey's tincture of salt of tartar.

P R E P A R A T I O N.

Take black tartar of the 55th Process, powder it in a hot iron mortar, put it into a glass viol, pour in common brandy to four fingers height above it, boil it for 24 hours gently in our wooden furnace, and you have a black, thin, bitter, aromattick, lixivial liquor, pour it out clear; this is a good menstruum, consisting of water, acid, alcali, and alcohol; it dissolves vegetables, is good to deterge and dry humid and virulent ulcers; it consumes luxuriant flesh if mix'd with a little oil; 'tis good in phlegmatick watry, acid, and terrestrial diseases; it opens obstructions, therefore is good in anasarca's, green-sickness, jaundice, cold gouts; 'tis diaphoretick, diuretick, and laxative: Take two or three drams of it, an ounce of the syrup of opening roots well diluted with fennel-water, take it in a morning three or four times; but 'tis bad where putrid diseases reign. See *Gideon Harvey* and *Dioscorides*.

P R O.

P R O C E S S LXXX.

Helmont's tincture of salt of tartar.

P R E P A R A T I O N.

Take pure salt of tartar, as in Process the 12th, then put it into a viol with a broad mouth in which is contain'd pure alcohol and hot, let the neck of the viol be warm, pour the salt of tartar into it hot from the fire thro' a paper funnel, which will make it boil, stop the viol with cork; pour afterwards, when all is cool, more alcohol, till the viol be three quarters full, shake the glass that nothing of the salt stick to the neck, for this moistening would spoil the operation; put 'em in 100° of heat gently stoppt, and you will have a fine red tincture, which will be, if the liquor be inspissated by distilling, very saponaceous. *N. B.* If any air gets in, you can never get this tincture; hence these rules given must be strictly observ'd.

Its Uses.

Hence appears how salt of tartar attracts water, acid, and oils; hence appears a new manner of getting soap, as you may find by exsiccation of this tincture; it does not effervesce evidently with acids, nor so readily precipitate any thing dissolv'd in acids; the soap we get from it by distilling off the alcohol is a blackish red; it dissolves distill'd oils presently; it makes a tincture from lac, myrrh, and amber; 'tis good in acid diseases, it must be diluted in water to be given internally; it appears that spirit of wine distill'd from salt of tartar is half water. I have found, that the tincture of salt of tartar digested for a great many months with alcali, and laid aside for four years, the salt was

was dry at bottom, and the tincture red at top; then inverting the glass, and pouring out the tincture and salt into a glass cucurbit, they were very fragrant; I distill'd this alcohol, which was limpid and fragrant, but the salt at bottom was red, which before was white: I pour'd this alcohol again upon the salt, which did not distill so freely; this alcohol was fiery, and the salt at bottom was blackish red; I repeated this distillation for 21 times, the salt at bottom was black, and the alcohol most acrid; I encreas'd the fire to a great degree upon a sand heat, water came out, but no alcohol; hence it appear'd that the salt and alcohol contain'd water, but not to half the quantity of alcohol; and I am apt to believe the air produc'd this water: I have also found, that this salt would never turn volatile, tho' I have distill'd 22 times (b). This salt expos'd, run into a very acrimonious brown liquor; this experiment I tried to know the quantity of water in alcohol, and whether a volatile salt could be got from tartar with alcohol. How rich are people made by promises!

PROCESS LXXXI.

Elixir proprietatis with spirit of vinegar.

PREPARATION.

Take choice aloes, saffron, myrrh, half an ounce, being bruis'd and cut small, pour on 20 times their quantity of spirit of vinegar, boil for 12 hours in

(b) Pray what is it that makes the spirit of wine so fiery, but the salt of tartar? Is not then some part of the salt of tartar in this cohobated alcohol? Therefore this acrimony is part of the tartar turn'd volatile, which we can prove by collateral proofs.

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a high-neck'd glass, let them cool and settle, decant; pour on more spirit, boil and decant as before, distill, inspissate to one third.

Its Uses.

I take this spirit to be better than oil of sulphur, because it hardens the gums, and hinders them from uniting with the alcohol; it is good in ulcers any where, and internally is good in phlegm, and worms; it purges, sweats, and promotes urine; it is given in a morning from one to two drams; it answers *Rufus's* pills which are good against the plague.

P R O C E S S LXXXII.

Elixir proprietatis with distill'd water, or any aromatick water.

P R E P A R A T I O N.

Take aloes, saffron, and myrrh, q. p. powder them, pour upon them in a bolt-head 20 times their weight of scurvy-grass-water, prepare as before.

Its Uses.

This always breeds a mother; it is good as in the former preparation.

P R O C E S S LXXXIII.

Elixir proprietatis with a fixt alcali (12.)

P R E P A R A T I O N.

Take the aforesaid ingredients bruis'd, put to them oil of tartar, digest in a bolt-head; pour on
any

any aromattick water, or alcohol once or more rectified, or aromattick spirits, which you may repeat till all the tincture is drawn out; boil, decant, and distill, till you have a thick liquor like oil.

Its Uses.

It is good in all acid cases, watry, phlegmatick, cold, scirrhus and cold obstructions; it is a nerve medicine, emmenagogue, antihelminthick, antiscorbutick, appetising, supplies bile, and breeds milk.

P R O C E S S LXXXIV.

Elixir proprietatis with tartar tartaris'd.

P R E P A R A T I O N.

To the same species, pour on tartar tartaris'd to thrice the weight of the ingredients, in a bolt-head, digest for three days in 150° of heat; the species dissolve into pap, better than with the above-nam'd liquors, then pour on 20 times the quantity of alcohol, boil for 12 hours gently, let them cool, then decant; repeat this work till all the tincture is drawn off, then inspissate with a gentle fire to the thickness of oil.

Its Uses.

This is better than all the preceding; it is deobstructive, good in chronical, acid cases, nor does it injure alkaline diseases.

P R O C E S S LXXXV.

Elixir proprietatis with tartar regenerated.

P R E P A R A T I O N.

To the aforesaid species pour on thrice as much of the liquor of this tartar regenerated, all will be dissolv'd; then pour on alcohol 20 times as much as the weight of them, boil 12 hours gently, and do as above; inspissate to half, the alcohol serves again; the elixir is thick and turbid.

Its Uses.

It is excellent in chronical cases to dissolve the juices; it stimulates the nerves, deobstructs and dissipates tumours; this I repute *Paracelsus* and *Helmont's* elixir; we see then various dissolvents of these species, and the virtues differ according to the menstrua; with diaphoreticks, diureticks or catharticks, they sweat, promote urine or stools; all, except that with water, preserve from putrefaction; they are all, except that with acids, good in caries; saffron is cordial, aloes purges, myrrh antiseptick; but in hæmorrhages, bleeding piles, or in agitated humours, they hurt.

P R O C E S S LXXXVI.

The analysis of foot.

P R E P A R A T I O N.

Take the blackest baker's (wood) foot, fill a glass retort, fit a large recipient, lute with linseed paste; give a fire of 150°, a clear water ascends: take this water away, clap the recipient on again,

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a yellow volatile salt ascends, then a black oil; let all cool, you find in the neck of the retort a salt, and at bottom a black dreg, which at top is a *sal armoniac*; rectify the white water, you get a volatile spirit and an oily volatile salt.

Its Uses.

Thus we learn what soot is and affords by a chimney and a retort; 1. a fetid spirit, in both waters; 2. a volatile salt that is oily, as appears by its smell, taste, and effervescing with acids; 3. a volatile spirit; 4. a blackish fetid oil; 5. a *sal armoniac* which is found on the earth, which heats not with acids, and with any fixt salt affords a volatile salt; 6. an earth, which by calcining turns white. See then what flies into the air! soot made into pills gilded helps cold diseases; its *sal armoniac* is good in cancers, says *Hartman*: Soot differs according to its materials that are burnt.

PROCESS LXXXVII.

The analysis of amber.

PREPARATION.

Put amber bruis'd into a glass retort with a wide neck, give a fire of 212°, a limpid oil comes over; change the recipient, lute again, there comes over a red oil; change your recipient, then comes over a salt, and a red oil; encrease the fire, a black oil ascends, thick as turpentine, and lastly a black flatulent matter, which would burst a narrow-neck'd retort; all these may be rectified; at bottom is a sort of jet.

Its Uses.

Amber is a sort of petroleum; the salt is an *acid*, that dissolves in alcohol; the oils are balsamick, diaphoretick, diuretick, emmenagogue, antihysterical; the salt antiseptical, stimulates the nerves and agitates the spirits; how does this amber differ from its parts!

P R O C E S S LXXXVIII.

The putrefaction of vegetables.

P R E P A R A T I O N.

If you put fresh herbs into a hogshhead and press them down, the harder the better, they begin to heat, and putrefy and smell, and if distill'd, they will afford water, salts that are volatile, and oils of all sorts, limpid, red, and black, and an earth at bottom, but no fixt salt, which before putrefaction they would have done; nay, Sorrel putrefied does all this, and 'tis commonly experienc'd in hay.

Its Uses.

If the bodies fall into flames, nothing is afforded; hence we see how all bodies, how different soever, even acids, &c. afford these principles by putrefaction; hence our victuals putrefy in us. This differs from fermentation in the following manner; putrefaction requires a greater compression, density, and thickness, than fermentation; it acts on all vegetables, not so fermentation; it requires a greater heat than fermentation, which requires not above 70° , except in vinegar; putrefaction makes the salts volatile, and the oils fetid, and almost the earth too; whereas fermentation
makes

makes the acids volatile, and the alcali's fixt, the oils fragrant, makes an acid tartar; this then makes volatiles, and fermentation fixt ones, and acids, compounded of oil, acid, spirit, and earth; this makes a simple volatile alcali, and fermentation turns the saline into an acid, and the remainder into a saline that is fixt: They then who think there is no difference between these two actions, I shall not dispute with them; putrefaction in short, by a greater fire or heat, moves the air, and expels all things in a short space; whereas fermentation by a smaller heat gradually attenuates, and moves the inflammable spirits, or fires them: I only speak of the putrefaction of vegetables, and here I finish my demonstration on vegetables, where they are turn'd into the shape of animal humours. *Vid. D. Cox Phil. Trans. N^o. 100. p. 7002. N^o. 101. p. 4. (c).*

(c) There certainly is a gradual difference between these two motions; *the oils* by fermentation are more attenuated, but by putrefaction less; and the salts are more mov'd by putrefaction than the oils: So that altho' both be intestine motions, yet fermentation is a struggle made principally between the oils and detach'd acids; and putrefaction is caus'd by a mutual attraction between the salts; how or why there should be this difference, I shall briefly remark.

And it appears that fermentation is made between the detach'd acids and oils, that are loose, but that putrefaction is rais'd among those parts that are hardest to dissolve; for after fermentation is over, the remaining dregs left to putrefy do afford volatile salts and oils.

And moreover, where is the difficulty of assenting to the ancient way of talking, where *fermentation* being taken, and very justly, for a general term, is divided into a *perfective* and a *corruptive* one? by the first we have winy liquors, and by the latter volatile salts and oils: But for want of somewhat momentous, men often dispute on trifles.

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P R E F A C E.

'Tis evident from the 88th or last Process, that plants will turn volatile and alcalious, and that the oils will putrefy, let them be of what kind soever, as animal juices do; hence, 1st, All things in animals are chang'd and fly off, so that they are not the same to day and to morrow; our nails, and broken bones, being repair'd, our hairs falling off, and our secretions continually going on, convince us of this truth. 2^{dly}, As the egg of a pullet grows heavier by hatching, as the body of a child grows up to that of a man, so what flies off is repair'd daily. 3^{dly}, Our aliments are taken principally from vegetables and animals, and from some fossils or salts, &c. and the *Brachmans* and the *Pythagoreans* live long by vegetables and water. 4^{thly}, Most animals we feed on live upon vegetables, the larger fishes devour the less, or insects, and some birds live upon animal prey, yet most of 'em live upon vegetables; 5^{thly}, wherefore a human body lives mostly and secondarily upon vegetables: 6^{thly}, A chymist therefore ought to know the nature of vegetables. 7^{thly}, We now must observe how vegetables lose their natural condition, and turn by the actions of a human body into putrefaction; and having seriously consider'd what ought first to be treated on, I have chose milk for my subject. 8^{thly}, Milk is the proper nourishment of man, for all we receive turns into chyle or milk; from this are nourish'd all the parts of the body, from this are supplied all the secretions; in the stomach, indeed, there are signs of fermentation

fermentation and putrefaction; the chyle is a sort of emulsion, the victuals being ground by the teeth as in a mortar, and diluted with the juices every where, as well as press'd by the stomach and muscles of the abdomen into a milk which has cream: The best is human milk, next to that asses, then mares, goats and cows milk; 'tis good in atrophias; the runnet coagulates this milk, and turns it into a caseous and serous matter; if it be put upon the fire, it turns into butter and cheese; this is a middle liquor betwixt serum and an emulsion; and the chyle differs according to the nature of the aliments we feed on.

PROCESS LXXXIX.

New cows milk is not sour, has no alcali, is scarcely salt, and has no spirit (45, 49.)

PREPARATION.

1st, The taste, the smell, and dropping it into the eye, produce no troublesome sensation. 2^{dly}, Heating it, and adding a volatile or fixt alcali, no effervescence ensues, only disturb the liquor, and inspissate it a little. 3^{dly}, By pouring in spirit of vinegar, or any other acid spirit, there ensues no effervescence, only a coagulation. 4^{thly}, Oil of tartar pour'd on to milk coagulated with oil of vitriol, there ensues a most violent effervescence, greater than if pure alcali and oil of vitriol had been mixt together. 5^{thly}, New milk put into a glass cucurbit and distill'd by 160° of heat, there first ascends a watry liquor that neither effervesces with alcali or acid; this water neither tastes, smells, nor feels to the naked eye any way biting, but is rather fatty and sweetish, and has no saltishness in it.

Its Uses.

Behold, my most desirable hearers, the nature of milk examin'd chymically, nothing appears of fermentation or putrefaction, hence cannot we account chymically for chylicification; however, as milk changes in 12 hours, so if long retain'd in us it begins to corrupt. This experiment was made on cows milk; there are, however, some who affirm there is a latent acid in milk, they must therefore affirm this from the effects produc'd on our senses, for there's no such thing appears chymically (*d*).

P R O C E S S X C.

New cows milk is coagulated with acids, even whilst a boiling.

P R E P A R A T I O N.

Pour on vinegar, spirits of nitre, or salt or oil of vitriol, the milk turns into curds and whey; the curds are cheese, which is hard, and frames our solids, and burns and smells.

Its Uses.

Hence, as the milk curdles and keeps still white, it becomes obstructive, and acid diseases make people pale-colour'd, belch and sweat sour.

(*d*) There are so many reasons to convince us that milk contains acid, that the professor must either be weak himself, or deems the world to be such: For in the first place, effervescence is not always necessary for the discovery of an acid, or we should find no silent precipitations; moreover, what is that perturbation and inspissation that ensues upon pouring in a volatile and fixt alkali, spoke of in the 2d paragraph of this Process, but the effect of an alkali and an acid.

P R O-

P R O C E S S XCI.

New cows milk put upon the fire and boiling with a fixt alcali, coagulates, grows yellow and red.

P R E P A R A T I O N.

To milk boiling diluted with a little water, pour in drop by drop oil of tartar; it grows yellowish and then red, and by degrees it coagulates.

Its Uses.

Hence we see how alcali's turn the milk into blood; so it is that the milk of nurses in fevers is yellow, tastes saltish, and coagulates in their breasts; not from the acid, but from the too great heat evaporating the fluids; hence coagulations in fevers are not always from acids; hence in the last plague among the cattle, the cows milk was yellow and fetid, and their stomachs were dried up with heat; hence it appears that the whiteness of the milk depends upon some acid in the blood, and such persons are always pale, and are to be restor'd by alcalious medicines; hence the colour depends upon the nature of the blood; it does not always happen that alcali's will dissolve coagulations occasion'd by acids.

P R O C E S S XCII.

The urine is not acid, nor alkaline, but 'tis fetid.

P R E P A R A T I O N.

Take the urine of a sound person twelve hours after their eating or drinking, mix with it oil of Tartar or spirit of salt armoniack, it does not effervesce,

fervesce, neither does it fall into any heat with acid spirits, after it has staid twelve hours in the body 'tis thoroughly digested ; neither does it effervesce altho' the person drinks *Rhenish*, uses a great quantity of vinegar, and lives upon acid plants ; neither does it turn the juices of herbs green as alcali's do.

Its Uses.

Hence it appears, that the salts of the urine are neither acid nor alkaline : I have tried the urine of a person which had been suppress'd for five or six days, yet could find no sign of an alcali in it ; but another person whose urine had been retain'd from a stone in the bladder, when extracted, struck the surgeon with its putrefied smell so much, that he was ill for some days ; hence false chymistry, that has cry'd aloud there are alkaline salts in the blood of sound persons, is now set right, and that there is only a sort of sea-salt in the urine which makes it bitter and ungratefully salt.

(e) We shall presently see in the 95th and 97th Process, how this gentleman will contradict himself ; 'tis therefore not a sea-salt but an armoniacal one, where by mixing a fixt alcali along with it, and calling it off, we get a volatile spirit and an acid ; but sea-salt does not contain a volatile salt.

P R O-

PROCESS XCIII.

Fresh urine distilling from vessels close shut affords a fetid, nauseous water, not alkaline, not acid, not saline, nor spirituous as wines.

PREPARATION.

Take the urine of a sound man, boil it and then distill it with 150° of heat, until the 20th part remains at bottom, and you have limpid water that in the still grows redder as you distill more off, till at last it becomes thick and blackish red, this limpid water is fetid, but has no volatile alkaline smell, which smell it retains if repeatedly distill'd or expos'd to the air, nor is it abolish'd by pouring on an acid ; it has the smell of a new dead body, the taste of it ungrateful and nauseous, but not alkaline ; when distill'd it has not those streaks which the winy spirits have, it extinguishes flame, nor is it spirituous, though distill'd from persons drinking strong liquors, it does not effervesce with acids, nor change the colour of blue plants into green, it did not much precipitate bodies which acids had dissolv'd, it never shew'd any sign of salt, whether acid, alkaline or neutral.

Its Uses.

Hence it appears to be some volatile oil, that is light and mixes with the water, and can't be separated from it ; it seems to be like the *perspirabile*. The fermented spirits of vegetables do not pass by urine, they may perhaps pass through the pores ; hence we know there is no volatile salt in the blood whilst 'tis no hotter than boiling water ; let others think what they please, there is nothing

thing of a volatile acid in it, how much then is physick to be alter'd; this foetor encreases with the blood's motion, 'tis therefore nothing but oil (*f*).

P R O C E S S X C I V.

The urine remaining after the last Process is neither acid nor alcali, but saltish, fetid, altho' not saponaceous.

P R E P A R A T I O N.

If we mix acids or alcali's with this remainder, there is no sign of an effervescence, but it has an acrimonious bitterish taste and smells strong, nor does it cleanse woollen clothes as alcali's will do: Till it putrefies, it has nothing chylous nor lymphatick in it, neither any thing caseous, but the more we inspissate it by fire, it tastes more acrimonious and is deeper colour'd, as appears in acute diseases.

Its Uses.

Therefore there's no volatile alcali in a sound person, nor any acid; 'tis therefore a peculiar salt of itself; it contains nothing nutritious, therefore no such parts are voided along with it, therefore 'tis excrementitious; hence the thickness of

(*f*) This author still proceeds upon a mistaken Notion. He supposes that there is no alcali in the blood, unless there be an effervescence; but a silent precipitation of bodies dissolv'd in acids is a sufficient proof of the presence of an alcali, and as he tells us, *non precipitabat multum quæ in acido soluta fuerunt*. This is a Proof there is some alcali in this water; and as the precipitation was not great, then the quantity of salt was but small, but *ipso facto*, as he owns it a light volatile oil, it therefore partakes of a volatile salt.

the

the urine, its small quantity, its high colour, and its acrimony, from whence diseases are produc'd, shew a necessity for water to dilute.

PROCESS XCV.

The same urine inspissated to a 40th part and then distill'd, being mixt with sand, gives out an alkaline volatile salt, a most fetid oil, and saline dregs.

PREPARATION.

Distill or evaporate 40 pound of urine to one, to this one remaining part add three parts of sand; distill in a sand heat by a gentle fire, often removing the recipients; first comes up a limpid water as before, next a limpid alkaline liquor; then lute your recipient and encrease your fire, then come up white clouds, fatty streaks, an oleous liquor, and an alkaline salt, then a yellow oil, the fire being encreas'd to the last degree, and there remain the dregs saltish at bottom; the first water is scarce alkaline, the second is very much so, effervesces with acids, and makes a neutral salt like salt armoniac, and is truly a volatile alkali; the next is an oleous alkaline, the last oil is intolerably fetid, and the dregs are a sea-salt.

Its Uses.

Hence the salts of the urine are made volatile by a certain degree of fire; this urinous salt is not armoniacal, for salt armoniac being made volatile by a certain degree of heat, yet being sublim'd, is never alkaline, but a mixt salt; whereas the salt of urine is truly alkaline, it approaches to the nature of an alkali and armoniac salt, and yet is neither of 'em, it appears that the salt, the
saline

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saline spirit, and the first oil, are equally volatile in the sound state; it appears also that this fat spirit is water, oil, and salt, by analysis: Hence do we see the force of nature, which is gentle, changes all into acid, fetid, &c. hence we see there is no fixt salt in our humours, for I never could find any in urine, only there is a sea-salt in it: This is *Helmont's* experiment, and 'tis of great use in physick (g).

P R O C E S S XCVI.

Fresh urine inspissated distill'd with a fixt alkali.

P R E P A R A T I O N.

Fresh urine being inspissated as before, pour on oil of tartar or pot-ashes an equal quantity, and a volatile vapour arises immediately, as soon as it grows warm, as if the urine had been putrefied; distill from an alembick and there ascends a clear liquor, which in every respect is alkaline; if instead of the oil you put salt of tartar, you then get a volatile salt at the first distillation; rectify this alkaline liquor in a high cucurbit, the first part is white and alkaline, the alkali keeps the oil at bottom, but encrease the fire and it rises.

Its Uses.

From this experiment we see the urinous salts are chang'd into alkali's; hence it is known that fixt alkali's change our salts into volatiles in an instant, as if it had been done by putrefaction, and

(g) We are now come to that Process where it fairly appears there are volatile salts in our urine; in the urine there are a great many tenacious parts, and from hence a great force of fire is requir'd to drive 'em up, so 'tis in hartshorn and some other bodies.

you

you may rectify 'em as you do Hartshorn; they effervesce with acids, hence we see a great mutability of our salts into various species; (b) in ardent fevers *Hippocrates* advises acids, fixt salts are dangerous in such cases; acids change them, and correct their acrimony and fix them, lest they should fly off.

PROCESS XCVII.

Quick lime being mixt with fresh urine inspissated, gives a fiery but not an alkaline spirit.

PREPARATION.

To very fresh urine throw in quick lime, in an instant a fiery spirit strikes your nostrils; join the retort and recipient, give a gentle fire and distill, you have limpid liquor intolerably fiery hot and volatile; but if you inspissate the urine to a 40th part, and add equal parts of quick lime, you get a spirit inimitably strong; this last spirit will never prove a salt by rectification; this spirit does not effervesce with acids, but its heat is diminish'd by 'em: As soon as you mix the lime there is a great effervescence, and if you hold your head over it, it will endanger your lungs; if this last spirit is applied to the skin, it will gangrene it; it flies off immediately in the air.

(b) From the same way of reasoning may it be inferr'd, that salt of tartar mixt with salt armoniac, or with cheese, does instantly change the salts in them into volatile ones; whereas the truth of it is, that the acid in these two bodies and the fixt salt do only attract each other more strongly than the volatile did the acid, and not change any thing; therefore the volatile is not made, but in an instant set free, which plainly proves a pre-existence of that salt in the bodies.

Its Uses.

Hence lime mixt with our humours, join'd with a little heat, produces fatal disorders; the more acid and phlegmatick are our humours, the more good will prudent giving of it do. The lixivium of lime does good in muriatick diseases; hence in a cold scurvy it is useful, but in a hot one 'tis hurtful; hence have the *Germans* succeeded with the lime water, whilst the *French* are hurt by it; the stronger the lime, the stronger the lixivium; hence first, the corrosion of lime depends upon its making our salts fiery; hence in acid, watry, phlegmatick diseases, in slow circulations, and where a stimulus is wanting, these salts are good, but in alcalious and hot bloods, bad; hence mild humours may be made fiery and poisonous in an instant; hence an acid may be made most acrimonious, and yet be neither a salt, spirit, nor an oil; hence this spirit, tho' not alkaline, is stronger than any alcali, and affects our taste and smell more violently.

P R O C E S S XCVIII.

The natural salt of urine.

P R E P A R A T I O N .

Take fresh urine of the last digestion, give 200 degrees of heat, and exhale it to a thickness, strain it thus hot, put it into a cylindrical glass, cover it with paper, let it stand for a year in a cellar, and a brown clearish salt gathers at bottom, a fattish substance swims at top; take out this salt, pour cold water upon it, and clean it and keep it; if you dissolve it in warm water and exhale to a pellicule, it concretes into crystals like sugar; it neither smells, nor is alkaline.

Its

Its Uses.

This is a sort of sea-salt, but not only so, 'tis diuretick in water, and diaphoretick, the thick matter remaining is proper to produce the phosphorus; the salts by this method do not grow alkaline: May not this salt be good in the stone?

P R O C E S S XCIX.

Milk digested affords a cream and grows sour.

P R E P A R A T I O N.

Set new milk aside and 'twill afford a cream which is soft, not acid nor alcali, which you may take off and repeat the operation; the milk remaining is call'd skimm'd, or blue milk; this cream is balsamick, lenient, good in consumptions, nephritick cases, and the gout, good in ulcers and wounds; if you put this liquor in 60° of heat, cream and milk both sour, and cream itself grows sour in this manner sooner in summer than winter, sooner in the milk of those fed with grass than dry hay, &c. and if the animals are of a hot nature, have been much exercis'd, or have fed upon alcalious plants, the milk then grows alkaline, and children sucking such milk, which is generally yellow, grow sick.

Its Use.

Hence milk contains a great deal of oil, which easily parts otherwise than in soap; it easily divides from the watry part and runs into the fatty cells; it easily turns acid; it easily also turns bitter and rancid by great heat; hence will it produce either alkaline or acid diseases, as it is managed.

P R O C E S S C.

The urine digested turns alkaline, and changes its colour, smell, taste, and properties.

P R E P A R A T I O N.

The urine being digested in a heat of 33° , will turn putrid, higher colour'd, and alkaline, and prove of use for fullers and diers, to cleanse their wools or filks as alkalines do, and will effervesce with acids; hence do physicians learn the condition of our humours by the colour of the water; we learn from hence, that if the urine be retain'd it may produce dangerous disorders; we learn also, that our humours do not ferment but putrefy; hence we see the use of water and acids in warm countries, and to correct hot bloods; hence in burning fevers prisans and oxymel are good; the stone is produc'd from putrid urine; hence alkalines are good to hinder the production of the stone. I have, with amazement, seen urine set by to putrefy, and have gather'd a strong crust from the vessel it was put in; a heat of 80° will putrefy bodies, but sound chymistry shews us what diet, &c. will prevent putrefaction, which if it could not be done, people in ardent fevers must die.

P R O-

PROCESS CL.

Urine digested and distill'd affords alkaline spirits, a fetid oil, a volatile oily alkaline salt, a phosphorus and a sea-salt.

PREPARATION.

Take urine digested, as in the last process, distill in a glass cucurbit with a gentle fire; 1st, comes fatty *Striæ*, change your recipient; distill on, comes water over; mixt with a yellow oil, fetid, and salt, burn the black remainder, and you get a sal marine.

The water effervesces with alcali's, and rectified in a high glass, gives salt that is alkaline, and the water at bottom is fetid; distill on, it affords a volatile spirit, and *Helmont's* lithontriptick water.

There is no fixt salt to be found, 'tis only a marine one.

When I want a large quantity of volatile salt, I take 100 ℥ of urine, I inspissate to the consistence of honey, I expose this for some months to putrefy, then I distill from an iron pot, which has an earthen alembick and fit a large receiver, I give a fire gradually, I get a white volatile salt, and by encreasing the fire, a yellow oil, then an oil and salt, take the receiver off and keep them apart; mix what rests at bottom with two or three parts more of charcoal, and encrease the fire, and the phosphorus mounts and falls into the water like wax, and keeps for 20 years there. *Boyle, Act. Lips. 1683. Homberg 1692. p. 520. Hoffm. 336.* And from the fœces burnt, we get

a sea-salt, as appears, because it being mix'd with *aqua fortis*, dissolves gold (*b*).

Its Uses.

Putrefaction makes the salts and oils more acrid and fetid; we find no inflammable spirit, no acid, or fixt salt here, but all volatile; and a sea-salt; and an acid from the drugs and the phosphorus has an acid in it, when dissolv'd in the air, whence this acid? I know not. *Homberg Act. R. Sc.* 1706. p.340. *Memoires de Math. & Phys.* 1692. p.80. This acid is like oil of vitriol, is there any alum added in getting it? for we don't find it in birds dung fed with vegetables. (*i*).

Rectify the spirit, it becomes very limpid, and kept, has earth at bottom, that dissolves by more spirit. Alkali's breed the stone, sea-salt is good against it and putrefaction; vinegar, sulphur and sea-salt, which put in wine are *Hippocrates's* antipestilential remedies.

PROCESS CII.

The origin of salt armoniac.

PREPARATION.

It comes from *Egypt*, it tastes like salt, has no smell, it flows in the air, it has long streaks, pellucid in the middle, &c. I have made it of soot, and 'tis made of urines inspissated, 10 p. sea-salt, 2 p. wood-

(*b*) This is no *Criterion* to prove this a sea-salt, for it may as well be a *salt armoniac* or *sal gemm*.

(*i*) Observe how this author is forc'd to acknowledge an acid in the urine at last, but knows not whence it comes, for it does not at all suit with his reasonings that preceded; and therefore he would gladly reject it.

soot

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foot 1 p. boil'd, strain'd, exhal'd, sublim'd, dissolv'd and coagulated. See *Worm.* and *Cassius.*

Its Uses.

It attenuates, opens, dissolves, stimulates, is sternutatory, diaphoretick, diuretick, antistiptick, preserves from putrefaction; dissolv'd in water and crystallis'd, these soft woolly crystals put into water in the time of dissolving, do cool Liquors immers'd; 'tis the *sal eyrenaicus*, from Camel's Piss, see *Pomet*, see *act. ac. Sci.* 1705. *Hist.* 83. 'tis an alkaline and sea-salt together.

PROCESS CIII.

Sal armoniac is neither acid nor alkaline.

PREPARATION.

Dissolve sal armoniac in thrice its quantity of water, heat it with 100° of heat, pour on any acid, there's no effervescence (except with oil of vitriol, (*k*) *vide* Process 106, 107.) and with a fixt salt, it does not effervesce, but a volatile smell ensues; therefore 'tis neither acid nor alcali.

Its Uses.

Hence 'tis a semivolatile sea-salt, for with *aqua fortis* it dissolves gold; it acts neither as alcali nor acid in us; it, as our humours, makes a volatile smell with fixt alcali's (*l*).

(*k*) *N.B.* Oil of vitriol effervesces with sea-salt specifically.

(*l*) Nothing is so ridiculous as for our author to affirm and deny in the manner he does, it is not this, it is not the other, 'tis both, 'tis neither, I know not what it is, are usual terms with him; and sometimes 'tis one thing, and then he thinks better, and rejects his first Thoughts.

PROCESS CIV.

Salt armoniac may be sublimed into flowers.

PREPARATION.

Powder salt armoniac, dry it, put it into an alembick, fit and lute a recipient, put it into sand, cover it with sand, give a fire of 150° , you get flowers very white, and salt armoniac; let all cool, take it carefully out, at the bottom of the alembick is an useless dreg.

Its Uses.

It neither effervesces with acid nor alcali, except oil of vitriol; it is semivolatile; the flowers are not pellucid, they lift up all bodies, as sulphur and calcothar depurated in water.

PROCESS CV.

Sal armoniac with lime gives a fiery spirit.

PREPARATION.

Take the flowers of sal armoniac, put them into a glass cucurbit warm'd, pour on as much powder of quick-lime, clap on the recipient suddenly, lute and distill, you get a fiery spirit, which is not alkaline; the mixture at bottom of the cucurbit is glassy, and shines like phosphorus. *Hamel. hist. ac. R. sc. p. 305, 306, 307, 308.* If you dissolve the flowers in 3 p. of water, and pour this upon lime and lute, you have a fiery spirit. The lime effervesces with the water, lute not till this heat is over. The mixture at bottom melts into sandy grains.

Its

Its Uses.

Its steams raise a smoak with those of spirit of nitre, then they are alcaline; hence from inodorous bodies, we get odorous ones, from dry we get liquid; observe a phosphorus.

PROCESS CVI.

Sal armoniac with a fixt salt gives a spirit and salt both alkaline and volatile.

PREPARATION.

Take flowers of salt armoniac, 10 p. fixt salt, 3 p. mix them and distill from a sand-heat, you get a fine, white alkaline volatile salt, that flies off, and thro' all but glass, at bottom is a fixt salt; or mix nine ounces of water and distill, you get a salt and spirit, and the fixt salt stays in the retort.

Its Uses.

Both salt and spirit are strong and alkaline, effervescing with acids, and acid steams of spirit of nitre; the salt and spirit rectified are stronger still; the salt apply'd and a pitch plaister over it, will mortify parts, and is it then adviseable to smell at these?

PROCESS CVII.

The examinaion of the fixt salt left from the aforesaid Process.

PREPARATION.

If you dissolve the remainder in water, inspissate and crySTALLISE them, calcine, &c. and you have *Sylvius's*

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vius's sal febrifugus, which taken before the fit takes off agues.

Its Uses.

This is a sort of regenerated sal armoniac, for 'tis fixt sal armoniac and sea-salt.

PROCESS CVIII.

A salt spirit from spirit or salt of sal armoniac and spirit of vinegar.

PREPARATION.

Pour on spirit of vinegar to the spirit or salt of sal armoniac, till the effervescence ceases.

Its Uses.

It is a natural salt, good against putrefaction, aperient, diaphoretick, diuretick; it is a discutient externally, especially in diseases of the eyes.

PROCESS CIX.

The white of eggs is neither acid, alcali, nor has it a vinous spirit.

PREPARATION.

We in 90° of fire pour on acids, we also pour on alcali's fixt and volatile, no effervescence ensues; mix these two together, and then they effervesce and swell largely, but return to their pristine bulk; distill with a fire of 100°, there is no spirit in the whites; it neither affects their eyes, taste, nor touch.

Its

Their Uses.

'Tis not acid nor alkaline, with 90° of heat it hatches; 'tis like the vitreous humour of our eyes, inclos'd in cells; it is soft and smooth, and viscous.

PROCESS CX.

The white hardens by the heat of boiling water.

PREPARATION.

With 80° of heat it putrefies; with 160° it hardens in water, and taken out of it sweats, and dissolves Myrrh and some other things.

Its Uses.

It is hard to say what fire does, a small heat dissolves, a great one coagulates, but a greater, 224° , dissolves what 212° had coagulated.

PROCESS CXI.

An experiment with alcohol and the white of an egg.

PREPARATION.

Alcohol, cold or hot, coagulates the white of an egg.

Its Use.

Wine mixes with it, but alcohol coagulates it, altho' alcohol blended with water does not.

PRO-

PROCESS CXII.

By distillation the white of an egg is dissolv'd.

PREPARATION.

Distill hard eggs in the heat of boiling water, you get an insipid water, neither acid nor alkaline, but soft; the whites at bottom are golden-colour'd and transparent, and shrunk; then put them into a glass retort, give fire gradually to the last degree, you get an alkaline spirit, a volatile salt and oil, and earth at bottom; rectify, you get a volatile salt, an oil, and a fetid water; the earth affords but little salt.

Their Uses.

Volatile salts are lighter than water. How comes it then that a volatile salt is produc'd from these whites, it was not such in them? see what the fire does! re-unite these, you never re-produce whites again; How different are these things from what chymists affirm of their principles?

PROCESS CXIII.

A fresh white of an egg putrefies.

PREPARATION.

In 70° of heat they rot, and afford a volatile salt, when they are rotted, they huff with acids.

Their Use.

Remark how the whites, when rotten, raise vomitings, &c. here is volatile made out of no volatile, a fetid oil from a smooth substance; by 90° of heat it hatches and nourishes.

P R O.

PROCESS CXIV.

Serum is neither acid nor alcali.

PREPARATION.

Blood let out turns into cake and water; mix any acid, no effervescence ensues; mix volatile or fixt alcali's, no conflict follows; mix these two together, a great effervescence arises, even in the cold: 'Tis gently saline, smells ungratefully, put into the eye it gives no pain, nor to ulcers or wounds.

Its Uses.

I have carefully examin'd the blood taken or running out of the body, yet never saw any sign of fermentation, rarefaction, effervescence, ebullition, or intestine motion; hence have I long since departed from *Sylvius's* and the chymists opinion; one would think this would appear in the moment of taking it away: If any persist in affirming it, and say 'tis gentle; how, I ask them, does it appear? if there are opposite salts in the blood, they are so inactive as not to exert their force (*m*).

(*m*) Here the author has made his last push! all intestine motion is hiss'd out of his school, and to enter no more there; but in the name of wonder what has he substituted? truly nothing; he has taken all the pains he is capable of to destroy the doctrine of *intestine motion*, but has settled no other in its place: But all the author has hitherto done is evidently erroneous; for he has endeavour'd to banish acids from our juices, and when he meets with them, he cries out, whence this acid? *Ignoro* (I know not) see him on the *phosphorus*; and when he, *en passant*, owns an acid in the salt of urine, he flurs it, and as his students make no objection, he hopes none besides will: And as for *intestine motion*, he takes it up again, as well as rarefaction, in *Process* 115.

2dly,

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2dly, The blood is a solid, that divides into a solid and a fluid, the serum, which has no sign of an acid in it, all is so calm and easy, no effervescences.

3dly, If there were alcali's and acids in our blood, there would be such expansions in it, that in an instant it might occupy ten times its natural space.

4thly, Serum contains all in it but the cake; hence all the secretions, all nutritious parts, and all necessary for repairs.

Behold, hearers, chymistry throwing out all stains that infected physics and medicine (n).

P R O C E S S C X V.

Serum of the blood digested putrefies.

P R E P A R A T I O N.

Let serum stand in 70° of heat, and it grows thinner, fetid, acrid, alkaline, and affords volatile alcali's.

Its Uses.

Hence obstructions, when the blood stands still and grows putrid, are often open'd spontaneously; the blood never grows sour on these occasions, it grows volatile; it affords no vinous spirit; 'tis true, putrefied liquors do rarefy, and being compress'd do undergo an intestine motion; acids as well as mixt salts and spirituous things hinder putrefaction.

(n) So that our author, like a top, goes round, but not forward.

P R O-

PROCESS CXVI.

Serum unites in boiling water.

PREPARATION.

Put serum into boiling water, it coagulates, like the white of an egg, but not so strongly.

Its Use.

Hence scalding water changes our serum; neither the saline part nor the oils are made volatile by boiling water.

PROCESS CXVII.

Serum coagulates with fire.

PREPARATION.

Put serum over the fire in a spoon, it coagulates; it parts with water, if expos'd to the air; but if it be gently coagulated, it parts with no water; 'tis of a smooth taste.

Its Use.

Hence 100° of heat renders our serum thick and stagnate, and so kills us; hence the use of *Fahrenheit's* thermometer in fevers is evident.

PRO-

PROCESS CXVIII.

Serum coagulates with alcohol.

PREPARATION.

Pour on alcohol to serum, they coagulate, and more if the alcohol be hot; 'twill keep without putrefying.

Its Use.

Hence it appears why hot alcohol stops bleedings, and hardens the fibres, and why the drinkers of it die of *polypi* or *scirrhi*: The serum is not so hard curdled as the whites of eggs; it is thinner naturally.

PROCESS CXIX.

The analysis of the blood by distillation.

PREPARATION.

1st, Take away sound blood, put it into a cucurbit of glass, in B. M. lute; put it in 150° of fire, a water, that's tasteless, effervesces with neither alcali nor acid, affects not the eye, not acrid, extinguishes flame, scarce odorous.

2^{dly}, Go on till no more ascends, this water is near 7 8ths of the whole.

3^{dly}, Break the cucurbit, take out the mass, it shews no signs of alcali or acid, 'twill powder.

4^{thly}, Put this mass cut into pieces into a retort in a sand-heat, distill, you gain an oily and a whitish salt, then a yellow oil and salt; then change your recipient, and give a strong fire, you get a black oil; here is a spirit, a *sal volatilis oleosus*,

fus, a yellow oil and a pitchy one, like as from the white of an egg. Let your retort be large, or the earth will swell and hinder distillation, and break all.

sibly, In the retort is earth and coal; calcine in open air, it grows white, which contains a sea-salt, which will give out an acid; hence serum and whites of eggs resemble each other; I question whether some speak truth, when they say they can get a phosphorus from this earth.

Its Uses.

The fetid water then is the most volatile part of our humours, as well as the greatest part; our natural salt is never so volatile, as to be elevated by a heat three times hotter than our natural heat: and yet we die with a heat that exceeds the natural one by 110th; hence as nothing volatile ascends by a heat thrice greater than the natural, there is nothing volatile then. (o)

The pitchy oil coheres strongly.

Without water nothing acts.

The heat, if small, incrassates; if greater, it attenuates; if 270°, it thickens it, beyond this it renders it alcalious.

PROCESS CXX.

Horse-hoofs distill'd.

PREPARATION.

Take clean horse-hoofs, put them into a retort, lute a recipient, distill in a sand heat, you get a.

(o) The argument is like this, to wit, Hartshorn does not afford a volatile salt without a great degree of heat, therefore there is no volatile salt in it.

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water, then a fatty streaky water, then a salt, an oil, more salt and red oil, and at last a black oil, and in the retort a black earth; and we get the same from horns, filk, nails, &c. and from hartshorn distill'd from an iron retort, and the earth is burnt hartshorn, good against worms.

Their Uses.

All these then afford the same things, only when there is most oil, the smell is most offensive; boiling takes off all the parts from bones and even the muscles, and leaves them dry and sapless, so a heart may be nicely examin'd, as to its fibres, if boil'd thus: Jellies the stronger they are, the less salts and oils they leave in the nerves. I know no difference between these spirits, *Goddard's* of filk and *Boyle's* of blood.

P R O C E S S CXXI.

Depuration and separation of such things, as are produc'd from a vegetable that is alcalious (33) or burnt (86) into soot, or putrefied (88) or animals (95, 107, 112, 119, 120); their virtues.

P R E P A R A T I O N.

Mix all that you distill together, give a heat of 150° , you get a spirit and salt; then give 212° of heat, the salt and oil ascend; thus you have a water, which you got at first, now a spirit, a salt and oil; the thick oil is at bottom, rectify the spirit with 100° of heat, you get a fine volatile salt, the water rests at bottom with oil; hence the spirit is a saponaceous body (being to be divided into salt, water and oil); the more the salt is sublim'd, the less oily is it: wash the oils in water, to keep for distilling the salts, put them into a retort,
distill,

distill, the oftner you cohobate on the earth, the finer are the oils, till at last you get a transparent and most penetrating oil, tho' you lose much of it, which made Mr. Boyle broach the mutability of principles; this oil cohobated 15 times is discutient, febrifuge, nervine, &c.

Salts are purified various ways; 1st, By resubliming from a sand-heat, and all salts appear to be the same. 2^{dly}, Resublime, putting powder'd chalk along with the salt, the chalk sucks up the oil and makes the salt whiter. 3^{dly}, If to this salt you pour on spirit of salt and resublime, you gain a fine salt, *Phil. Trans. ab. T. 3. p. 335.* All salts are the same, they only differ by the smell of the oils.

Their Virtues.

1st, These salts effervesce with acids and become neutral, and act as such then; 2^{dly}, They are caustick and attenuating; put a scruple of *sal. v. C. sal. arm.* upon the skin, apply upon it a pitch plaster, it makes a black eschar in eight minutes. 3^{dly}, Put volatile salt, alcohol, and water in an alembick, the salt flies off first, it flies off from your hand, it moves our juices, and stimulates our fibres, nostrils, lungs, &c. 4^{thly}, Hence are they good in acid, phlegmatick, watry and lax cases, and in stupors, &c. good in hysticks, hypochondriacks, spasmodick cases; they are emmenagogues in steams; but they are bad in hot and heftical cases, and in alcalious putrid blood; externally they are good to make issues, to eradicate warts, and *Hordeola* of the eyelids, by applying a little, moisten'd, to the part, and putting diachylon over it.

P R O C E S S CXXII.

Soap of volatile alcali and alcohol.

P R E P A R A T I O N.

Put strong spirit of salt armoniac into a dry glass, gently pour on pure alcohol, there is presently a coagulation white and opaque, shake them, hold down the neck of the glass, nothing falls out, but this presently melts again into a fluid; the saline matter concreting at bottom, sublime, and you get a *sal vol. oleos.* The cooler the season, the better the experiment succeeds; the liquors must be exactly pure, if we design to succeed; this is a most penetrating soap, and will deobstruct powerfully, and promote the circulation; good in jaundices without an inflammation; it neither dissolves nor hinders the concretion of stones; it melts in warmth, but in cold it keeps its shape; the soap will be stronger if you mix one 3d of the dry salt with alcohol; 'tis not stone; for it melts; 'tis call'd *offa Helmontiana*, and distill'd is call'd *Helmont's Alcabest*, but was first found out by *Raymundus Lullius*.

P R O C E S S CXXIII.

The volatile aromatick salt of Angelica.

P R E P A R A T I O N.

Take two ounces of fresh Angelica-roots dug up in *February*, finely sliced, put them into a glass retort, pour on 12 times as much spirit of wine once rectified, then add an ounce of salt armoniack bruised, three drams of salt of tartar; fit a recipient,

recipient, lute, and give 150° of heat, you get the salt first, and then the spirit of wine; when the watry part begins to come up and dissolves the salt, leave off from distilling, throw away the liquor at bottom, repeat this operation with fresh roots of Angelica to an ounce.

Its Uses.

The salt of tartar detains the acid of the salt armoniac; the salts of tartar, the volatile salt of armoniac, and the acid, help to dissolve the spirit of the Angelica; 'tis *sal vol. oleosum*, is good in all cold, phlegmatick, watry, acid cases; in defect of bile, in hypochondriack and hysteric cases; 'tis stomachick, warming, fudorifick, diuretick, antiparalytick, antispasmodick, and stimulating; we owe this to *Basil Valentin* and *Sylvius*: This example may serve for all the rest.

P R O C E S S CXXIV.

The production of a volatile, aromatick, compound salt.

P R E P A R A T I O N.

Take the compound spirit of 72, 24 ounces, put it into a retort, add six drams of salt of tartar, five ounces of salt armoniac, finely powder'd; distill, you have a volatile oily salt.

Its Uses.

This is better than the former.

PROCESS CXXV.

A preparation of a sal vol. oleosum.

Take any distill'd oil, two drams, dissolve 'em in 20 ounces of alcohol, alcaliz'd by 67, then mix two ounces of any volatile salt, and you have, by shaking 'em together, the salt we speak of.

Its Uses.

Thus may we extempore make any *sal vol. oleosum*; if then we know the virtue of any plant, we can mix the oil of that plant with these salts.

PROCESS CXXVI.

An extemporaneous sal volatile oleosum.

PREPARATION.

Take salt of tartar one pound, salt armoniac three pounds, any aromatics powder'd 12 pounds, spirit of wine rectified 36 pounds, mix 'em and shake them together, and you have the salt desired; or, take salt of tartar three pound, salt armoniac nine pound, put 'em into a cucurbit with any aromatick oil one pound, sublime with so gentle a heat that nothing but the salt will ascend; gather this, 'tis the *sal volatile oleosum* so much known in *England* against hysterick disorders.

Its Uses.

This is the famous *sal volatile oleosum* of *Sylvius* so much in use in *Europe*; 'tis dangerous in warm and inflammatory diseases; if it is much snuff'd up the nostrils, it destroys the *Membrana Schneideri*, and disposes to hæmorrhages; hence, by
putrefaction

putrefaction and distillation, we get a volatile spirit mixt with water; 2. a water nearly elemental; 3. a volatile salt; 4. a thin volatile oil; 5. a thick oil; 6. earth; 7. phosphorus; 8. sal-marine, where it has been made use of for diet, otherwise not (*p*); we can never return these to their former shape, part of the volatile salts fly off into the air and perform their offices in vegetation.

P R O C E S S CXXVII.

The phenomena of blood and serum in air, water, fire, acids, alcali's, neutral salts, spirits, oils and soaps.

P R E P A R A T I O N.

1st, With air from 32 to 94 degrees of heat it parts into serum and cake, it divides and putrefies and flies off; in cold air from 31 to one degree the serum is congeal'd, but when it thaws it putrefies and becomes volatile and flies off; in a heat of 120° to 214° it coagulates, but a greater than this dissolves it; it admits of a certain proportion of air. 2^{dly}, Water, from a degree of 32 to 94, unites with it; also it unites with it when boiling; if it be shaken, that will not keep it fluid, nor dissolve it when coagulated; it putrefies in water, if it be expos'd to the air; water then

(*p*) It is very observable that our author every where industriously endeavours to avoid owning an acid in animal juices; and as salt armoniac is an animal salt from our juices, he has avoided here also to shew us it contains an acid spirit; but that it does is evident, for take the *sal febrifugus*, powder it, mix it with bole powder'd, distill from an earthen retort with a reverberatory fire, and you get an acid spirit: Whether this be the acid of the sea-salt in our blood and from vegetable diet, 'tis all one, we must acknowledge there is an acid in our juices.

does not, whether hot or cold, dilute the cake of the blood. *3dly*, Fire, from 3. to 100°, makes it volatile; to 200° it coagulates it, but a greater putrefies and dissolves it. *4thly*, *Mozel* or *Rhenish* wine, vinegar, or its spirit, do only dilute the blood; spirit of nitre coagulates it into a black, spirit of salt into an ash colour; spirit of vitriol and sulphur into a white; volatile alcali scarce coagulates it, but makes it red; fixt alcali dissolves it; *sal volatile oleosum* coagulates a little; salt armoniac, nitre, salts of fountains, gem, of the sea and borax, make it red, and hinder its coagulating, so do common soaps and others; alcohol coagulates it, oils inviscate it: In all these we observe no fermentation, only change of colour. *Tartarus Tartarizatus* does the same as the last, so does *Venice* soap; *Helmont's* tincture of salt of tartar rather coagulates it, but not readily; that salt in Process 108, made of spirit of vinegar and volatile salt, attenuates, and keeps its colour. *5thly*, Vitriols make it thicker and change its colour; so *Vitriolum Martis* makes it black and coagulates it, so do *sacch. Saturni* and *merc. subl.* particularly the *oleum Mercurii* made with oil of vitriol; and yet mercurials given inwardly attenuate the blood.

Their Uses.

Thus we learn by mixing medicines with the blood what effects they have upon them; injections have taught us the same; however, when medicines are swallow'd we don't always observe these effects; effervescences are not made within the blood: *Paracelsus*, *Helmont*, *Cartesius*, *Sylvius*, and others use this form, when they would explain the effects of medicines in the body; some, forsooth, condemn acids, because they coagulate; *Hippocrates* says 'tis good in hot diseases, and yet the blood is incrassated in any of these; we can't safely say any thing

thing of the medicine till its species be determin'd, for some things that are reputed dissolvents, coagulate the blood.

The Third Part of Chymical Operations upon FOSSILS.

First, upon S A L T S.

P R O C E S S CXXVIII.

The trial of Nitre.

This is not the Nitre of the ancients, call'd $\lambda\iota\tau\rho\omicron\nu$; it is much us'd in preparations of fossils; it approaches in nature to the salt of vegetables and animals, and is in such as use no sea-salt (q).

It runs in a crucible, but does not flame till you throw in somewhat combustible. It neither effervesces with acids nor alcali's, when dissolv'd in water.

Its Uses.

Hence 'tis neither alcali nor acid, nor inflammable *per se*, but fuses and reunites (r).

(q) *Du Hamel.*

(r) Thus he argues on: 'tis neither, says he; because it is both, say I; for it affords an acid spirit and an alkaline fixt salt; and when it is already saturated, would he have it still effervesce? monstrous!

P R O C E S S CXXIX.

The depuration and crystallisation of nitre.

P R E P A R A T I O N.

Take common nitre, dissolve it in six times its quantity of water, boil and strain, exhale upon the fire to a pellicule, put it in the cellar, let it crystallise; or dissolve nitre in eight times the quantity of boiling water, strain, pour in oil of tartar till it is no longer disturb'd, boil till the water becomes limpid and a pellicule is at top, set in a cellar to crystallise; boil the remainder, till a pellicule appears, set it to crystallise, as before, apart, this do till nothing remains but a fattish liquor, it tastes acrimonious.

Its Uses.

This cools the blood, tempers the efforts of venery, makes the blood red, and changes into another nature in the blood, otherwise than common salt does; it preserves meat from putrefaction, and makes it red; 'tis good in inflammatory diseases, quenches thirst, and does not hurt with its acrimony: Crystallisation happens from the attraction of the salts to each other, and the repulses of the water and other salts which makes us distinguish this from others, for nitre is easily distinguish'd from sea-salt by its figure, it dissolves silver, but will not touch gold, but a little salt join'd to it makes it *aqua regia*, the crystallisation throws all the oil of tartar to the bottom, these crystals are always of a certain figure, and are pellucid, unless you lay them upon a glass and heat 'em by a fire, then they grow opaque, yet this opacity disappears upon a second crystallisation.

P R O

PROCESS CXXX.

Nitre with tartar becomes an alcali by fire.

PREPARATION.

Take nitre and cream of tartar, of each equal parts, powder them and dry them, put them into a cucurbit, throw in a live charcoal, a deflagration ensues, continue to do thus till all is deflagrated, and you have the alcali of nitre, white drawing upon a green.

Its Uses.

We see how the cream of tartar changes the nature of the nitre and gives a new salt that did not pre-exist it, that is alcalious in all its effects, it differs from other alcali's, and still retains some acid of nitre, because oil of vitriol makes it steam; there is no nitre in *Europe* but what has fixt salt of wood in it, this salt melts in the air. (s)

PROCESS CXXXI.

The alcali of nitre made with live charcoal.

PREPARATION.

Take pure nitre, put it into a crucible, let it stand on a charcoal fire till it runs, throw in a live charcoal, when the deflagration is over, throw in more, thus continue to do till it ceases to defla-

(s) Just now he told us that a fixt salt did not pre-exist, and you see he immediately subjoins that all *European* nitre has the salt of wood (which is a fixt salt) for its basis, thus he says on, and makes no bones of contradicting himself.

grate,

grate, then let it stand for some time, break the crucible and take it out.

Its Uses.

We see how great an impulse and repulse arises between the inflammable matter and the nitre: the nitre is not inflam'd by the coal, for as soon as the coal is consum'd, the nitre is at rest. (t)

The cinders after the deflagration, turn into an alcali that melts in the air, which deposit a great deal of earth, or if you dissolve this salt in water thoroughly, and inspissate all this water to the thickness of an oil, you have the same liquor that runs in the air, the earth that is deposited shews so much salt of wood concurr'd to the making of this alcali, 'tis call'd fix'd or alcalifate nitre.

P R O C E S S CXXXII.

Sal Prunellæ from nitre.

P R E P A R A T I O N.

Melt nitre in a crucible, pour it out upon a marble, dissolve this in rain-water, in which have been infus'd the flowers of red poppy, evaporate to a pellicule and crystallise, this is call'd *lapis Prunellæ*, or *crystallus mineralis*, reputed an arcanum and anti-inflammatory; or to nitre, 4 ounces melted in a crucible, throw in a scruple of flower of brimstone, it fulminates, this pour'd out, is *sal Prunellæ*.

(t) This paragraph is like the following, the spirit of nitre is not inflam'd by the essential oils, which it causes to flame; but pray what is it but the collision that raises this flame in a proper subject? The nitre is at rest, because part of it is fled, which caus'd this flame.

Its

Its Uses.

This has the same uses as the preparation in 129th, yea that is better; hence came the invention of gun powder, 'tis made of sulphur, nitre and charcoal, it has the name from the German word *die Eraune*, as was the herb *Symphytum Petraeum Lobelii* call'd *prunella* because it cur'd a quincy that was epidemical.

P R O C E S S CXXXIII.

Sal polychrestus.

P R E P A R A T I O N.

Take nitre, put it in a crucible, melt it, throw in a little pure sulphur, let them deflagrate, this continue to do till you have thrown in an equal quantity of sulphur to the nitre, this is the *sal polychrestus*; or mix the nitre and sulphur in equal quantities, and throw 'em in and deflagrate, 'tis the same salt, dissolve either of these in 5 times its quantity of boiling water, strain and crystallise as usual, 'tis neutral salt like the salt of hot baths.

Its Uses.

The sulphur contains an oil and acid, the oil and spirit of nitre go off and leave the acid and the sulphur united to the fixt salt, the deflagration you see which sulphur makes, is a neutral salt, whereas the charcoal made is an alkaline, the *Parisians* gave it this name, its dose is two drams in a morning, dissolv'd in 2 ounces and a half of water, drinking above it four or six ounces of whey, it sometimes vomits, often purges, and proves diuretick as well as diaphoretick; 'tis good in hot rheumatisms, opens obstructions gently, corrects putrid bile,

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bile, stimulates gently, good in acute diseases, certainly takes off tertians and sometimes quartans, if to nitre fus'd you throw in salt armoniac, it burns, this salt deserves to be enquir'd into.

P R O C E S S CXXXIV.

Glauber's Spirit of nitre.

P R E P A R A T I O N.

Take 18 ounces of nitre, put it in a glass retort, pour on 6 ounces of strong oil of vitriol, immediately clap on a large recipient, luted with lime, marl and sand, give a gentle fire, which encreased by degrees till all is come over, and you get the red spirit of nitre which always smoaks, stop it up close in a proper viol with a glass stopper, it will keep for years.

Its Uses.

The oil of vitriol presently falls upon the nitre and produces a choaking smell, which the operator must endeavour to avoid, this is true spirit of nitre, that has no oil of vitriol in it, as appears by experiments, and whether you put much or little oil of vitriol, 'tis much the same; the oil and the remainder of the nitre become a vitriolated tartar, the oil attracts the salt stronger than the spirit of nitre does, 'tis hard to conceive any principle in nature like this acid; this spirit of nitre we shall use for the future in our chymical operations; it was found out by *Glauber*, which he sold dear, kept it long as a secret, and then divulg'd it.

P R O.

PROCESS CXXXV.

Glauber's spirit of nitre dulcified.

PREPARATION.

Put into a high glass 8 parts of alcohol, prepar'd with any alcali, pour in gradually some few drops of spirit of nitre, shake 'em together, thus continue to pour on till there be one 8th part of spirit of nitre to the alcohol, digest and the affair is done. *Hoffman*; p. 121. I have often shew'd the dangerous effects of pouring these two spirits together, for pouring 2 drams of this spirit to 6 or 7 of alcohol, a strong ebullition follows, and a steam arises that will choak the operator.

Its Uses.

A strong effervescence follows the mixture of these two, and if you clap a candle to the steam it takes fire, runs into the glass and makes all fly, the smell is like that of southernwood, this dulcified spirit is anti-septical, balsamick, deterfive, dissolving and anti-putrid, appetising, carminative, nephritick, antiscorbutick, corrects stinking breath, and being well diluted with water makes the teeth white in an instant, but must not be imprudently us'd, its dose is 30 drops at a time.

P R O-

P R O C E S S CXXXVI.

The renewing of Nitre from 130, 131, 134.

P R E P A R A T I O N.

Take the fixt alcali of nitre, pour on gradually spirit of nitre, till the effervescence ceases, dilute this with water, exhale to a pellicule and crystallife; this is true nitre; its crystals are octohedral, prismatical and pellucid, as nitre; any fixt salt would serve this turn.

Its Uses.

Mr. Boyle wrote a whole treatise on this salt; it shews us how a most volatile, strongly smelling acid loses all its fierceness, and becomes a neutral salt; so great an attraction is there between an acid and alcali, the air is struck out during this conflict; this salt does not run as the alcali did; the alcali is feminine, the acid masculine: Whether all neutral salts arise in this manner, I know not, and I doubt it much; however, I certainly know that nitre is thus produc'd from the earth of animals and the fixt salt of vegetables or lime.

P R O C E S S CXXXVII.

Nitre regenerated not fixt.

P R E P A R A T I O N.

Take three ounces of the alkaline salt of nitre, dilute it with sixfold its water; pour in drop by drop spirit of nitre to the point of saturation, or till it ceases to effervesce; dilute with double the quantity of water, exhale to a pellicule and crystallife;

stillife; repeat this operation till you have got all;
this is true nitre.

Its Uses.

This experiment is the same as the former, and serves the same purposes; so from an odoriferous body is made one inodorous; from a hot caustic is made the coolest salt; from an alcali and acid is made a neutral, which, if fix'd, is a fine nitre; but if the salt be volatile, 'tis a semi-volatile nitre; hence, in an instant, is found that volatile nitre which the chymists heretofore labour'd so much to find.

PROCESS CXXXVIII.

Alcahest Glauberi.

PREPARATION.

Take the fixt salt of nitre, expose it to the air and it runs.

Its Uses.

This is the famous alcahest of *Glauber*, reputed as an arcanum, it differs not from oil of tartar.

PROCESS CXXXIX.

Nitre nitrated.

PREPARATION.

Take eight ounces of nitre dissolv'd in water, drop in 30 drops of spirit of nitre, evaporate to a pellicule and crystillife.

Its Uses.

Thus may we make it as acid as we please, but it flows ; it may be us'd in ardent fevers.

P R O C E S S C X L.

Vegetating nitre.

P R E P A R A T I O N.

Take the salt remaining at bottom after distilling *Glauber's* spirit of nitre four pound, oil of vitriol one pound, then all the spirit being expell'd, expose the salt to the air, it gathers a down as if it were vegetating ; dissolve it in water, exhale it to a dryness, and it branches out, but melts with heat and revegetates with cold: This was, I suppose, the chymists resuscitation of plants.

P R O C E S S C X L I.

Spirit of nitre with bole.

P R E P A R A T I O N.

Take pure nitre finely powder'd ℥jss, common bole 4 ℥ss, mix them, and put them into an earthen retort, fit a recipient, and lute ; give a small fire, which encrease by degrees till the retort is red-hot, you get the spirit of nitre, which however is not so strong as that of *Glauber* ; we get from the nitre 9 in 16, or one half ; I boil'd the remainder and inspissated it, it tasted alcalious, and prov'd such by pouring on acids, tho' not perfect: We must observe that the peat-turf's be warm, lest they break the retort, and take care of the smoke.

Its

Its Uses.

First, nitre melted affords no acid spirit, but runs thro' the retort and sweats off. *2dly*, Nitre with three parts of bole, marl or tabacco-pipe clay put into a crucible, does not run but sends forth acid fumes. *3dly*, Hence the interposition of the powders makes it afford the spirit, and perhaps the bole itself gives some spirit, for 'tis said bole us'd once will not serve again. *4thly*, Homberg computes the acid to the alkaline part, to be as 480 to 183, and I have produc'd 9 16ths; hence the acid did not pre-exist, which never appears without the fire, therefore produc'd by it. *5thly*, If colcothar or calcin'd alum be made use of, you get the spirit in the same manner, but the spirit of these two join in with the salt remaining at bottom, a strange transmigration! as far as we know the oils of sulphur and of vitriol are all one thing, and this joins in with the body remaining at bottom (*n*). *Aqua fortis* is but a spirit of nitre, whoever says that the whole nitre can be converted into spirit are mistaken. *6thly*, The fume of this spirit distinguishes it from all others, dissolves silver.

P R O C E S S CXLII.

Purification and crystallisation of sea-salt.

P R E P A R A T I O N.

Dissolve sea-salt in six times its quantity of pure rain water, strain often over till it becomes

(*a*) Will spirit of alum or of sulphur effervesce with nitre as oil of vitriol or spirit of salt will do? no surely, therefore they are distinct in their own nature.

clear and exhale one sixth part, let it stand till it settle no more, then exhale to a pelticle, set it in a cellar till it crystallises, this is for chymical uses, thus we may exhale and crystallise till no more crystals appear; if you inspissate and let it run, this salt flies all into the air.

Its Uses.

All salts crystallise into their proper forms, this salt dissolves gold, preserves meat from putrefaction, and if we mix salt with nitre and distill it proves an *aqua regia*.

P R O C E S S CXLIII.

Glauber's *spirit of salt*.

P R E P A R A T I O N.

To three parts of the aforesaid crystals, pour one of oil of vitriol, they effervesce, take care of the steam, clap on to the retort, in which they are, a large glass recipient, which lute well, clap under it a small fire, and you get the spirit, gently encrease the fire till all is got off, this spirit always smokes, but the smoke is pale, if you rectify it you get a strong volatile. 2. if you mix water along with the salt, and pour in the oil of vitriol gradually, the heat ensues, the spirit you get thus does not smoke; if you gently rectify this spirit, you get an acid water fit for juleps. 3. The *Sal mirabilis Glauberi* is at bottom of the retort.

Its Uses.

This is a strange production of spirit of salt by oil of vitriol, 'tis also strange that mixing the water hinders the steam, and that 100° of heat should

should produce a wholesome spirit (x); I could not get above one third part spirit free from water; this spirit is gratefully stomachick, appetising, a corrector of putrid salts, takes off gangrenes of the jaws and tongue, hinders the generation of stones, takes off the stranguries of old age; if to this pure spirit you add three parts of alcohol, you gain a balsamic acid, it dissolves gold, this was *Glauber's* invention also.

P R O C E S S CXLIV.

Spirit of salt with bole.

P R E P A R A T I O N.

First, Decrepitate salt, by this decrepitation it loses one 4th part of its weight; this decrepitation is necessary before we distill it, for otherwise it would crackle and break the vessels; take three pound of this decrepitated salt, bruis'd in a warm mortar, mix with it bole 10 pound, put 'em into two retorts, lute a recipient, encrease your fire gradually for three hours; then by encreasing your fire to the last degree, and distilling for six or eight hours, you gain the spirit; let all cool, take it out, you gain 3 from 8 ounces; boil the salt at bottom of the retort in water, inspissate and crystallise, you have a salt at bottom. *Beguinus* is mistaken in saying he could turn all the salt into spirit.

Its Uses.

This spirit requires a stronger fire than that of nitre, at the end a whitish yellow matter sticks to

(x) N. B. In the 151st Process he denies the pre-existence of an acid; here he cannot deny it.

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the recipient that is very styptic, the salt at bottom serves to make *Buttler's-stone*, for its virtues, see *Process* 143.

P R O C E S S CXLV.

Sal mirabilis Glauberi.

P R E P A R A T I O N.

Take the salt, remaining at the bottom of the retort after the distillation of spirit of salt, put it into a crucible till it flows, take care no coal fall into it, dilute with warm water, strain, impale to a pellicule, put it into a cellar, and you have an icy mass; dissolve this salt in 1x times as much hot water, inspissate and crystallise again, you have crystals that will not run in the air.

Its Uses.

This was *Glauber's* invention, which differs from *Tartarus vitriolatus* in its effects, for powder it, put to it three parts of vinegar, wine, beer, or water, it freezes them into ice; being fus'd in a crucible, and put into antimony, it dissolves it. See *Glauber, Boyle, Becker, Stahl, and Homberg*; it corrects putrefaction and gangrenes, 'tis purgative and diuretic.

P R O C E S S CXLVI.

Regeneration of sea-salt.

P R E P A R A T I O N.

Take four ounces of oil of tartar, put it into 12 ounces of water, heat it, put in drop by drop spirit

rit of *Glauber's* salt, or the other with bole, saturate till the effervescence ceases, let 'em settle, strain, exhale to a pellicule, put 'em in a cellar, crystallise, this is pure sea-salt.

Its Uses.

We see a compound salt arises from a mixture of acid and alcali; for the rest, see *Process* 136.

PROCESS CXLVII.

The regeneration of salt armoniac.

PREPARATION.

Take 4 ounces of spirit of salt armoniac, pour into it so much spirit of salt gradually as will saturate it, strain this liquor, inspissate to a pellicule, and crystallise or evaporate the whole liquor, and you have a salt armoniac at bottom.

Its Uses.

This is a semivolatile sea-salt, and a neutral one, 'tis hard to shew any acid in nature, unless, as *Mr. Boyle*, we could digest sea-salt so as to make it afford its acid easily, *Mech. qual.* p. 234.

PROCESS CXLVIII.

Tartarus vitriolatus.

PREPARATION.

Take three ounces of oil of vitriol, dilute with three p. of warm water, pour in oil of tartar till the effervescence ceases, strain

k 4

rate

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rate to a pellicule, crySTALLISE, and you have the salt; the metallick parts subside to the bottom, and the clearer 'tis from blue or green, the better 'tis, the same may be done with any volatile spirit; 'tis ponderous and aperient.

Its Uses.

It resists putrefaction and stimulates, we see how acids join'd to alkalis grow mild, how poisons may be cured, we find how water lurks in salts and how to extricate them, we see that 60 p. of spirit of nitre contain but 19 of true acid, that 52 of spirit of salts contain but 12 of acid, and that 60 of oil of vitriol contain 37 of acid, there are therefore few sincere acids, spirit of salt, of fountains and *sal gemm.* are the same thing.

Secondly, S U L P H U R S.

P R O C E S S CXLIX.

The examen of sulphur.

P R E P A R A T I O N.

Sulphur is of various colours in the mines, *viz.* yellow, red, and ash-colour; by melting it in a crucible it grows red and opaque when cold; it burns blue, and all of it consumes; its steam choaks; if it melts only and does not flame, its smoke is not choaking, by melting it flies all off, when cold 'tis friable, it flows like pitch, does not mix with water nor dissolve with alcohol, effervesces not with acids or alkalines; it purges, cures eruptions and worms.

Its Uses.

The chymists call it the resin of earth.

PROCESS CL.

Flowers of brimstone.

PREPARATION.

Take common brimstone six ounces, put it into an earthen retort, fit a glass recipient to it, lute with clay, ashes, and water, distill from a sand-heat; the neck of the retort must bend downwards; you gain the flowers; encrease the fire at the latter end so as the sulphur don't melt. This is enough for an experiment; but they who distill quantities, have a whole chamber for the recipient and another for the retort; hence the flowers are so cheap.

Its Uses.

This is only a depuration of the sulphur, and it serves better for liniments, &c. so long as the air does not come to the fire it does not flame.

PROCESS CLI.

Spirit of sulphur.

PREPARATION.

Take flowers of brimstone, put 'em into an earthen vessel, fuse the sulphur, then kindle it, hold over it a glass bell moisten'd with the steam of warm water; this bell must have a beak, to which you must join a receiver, then pour in more sulphur, and you get a spirit; the nearer you hold
the

the bell to the steam, the better; the moister the weather, the better; this spirit is very heavy, take care of the steam. *Homberg* found out another way, whereby he prepar'd 25 ounces in 24 hours; he prepar'd a large glass recipient, and made an aperture with a diamond of 8 or 10 inches diameter in the very center, and broke it off with a hot iron, and suspended it; under this he put an earthen cylindrical vessel, into which he threw the sulphur, which he kept continually burning, always throwing in fresh and taking away the crust, observing the former cautions.

Its Uses.

The flowers have no metal in 'em; the surface of it only burns, and so 'tis consum'd gradually; the vapour is fatal, because 'tis an acid; their steam stops fermentation and putrefaction; hence burning of sulphur is so anti-pestilential; the steam of it kills insects; all experiments shew us this experiment is oil of vitriol, only 'tis freer from the metal; sulphur contains a 10th part of acid; *Homberg*: Perhaps this is the reason it unites not with alcohol, and the reason why alcohol alcalised dissolves it; why sulphur is not dissolv'd by acids, and saturated with them admits no more; why metals are corroded by it, (x) for the acid and metal attract each other; hence let little chymists cease to fix sulphur, for 'tis already fixt; let them cease to fix metallic mercury, for it does not enter it, nor give the weight and consistence requir'd, therefore does not make it malleable: 'Tis good in inflammatory, hot, putrid cases, and *Helmont* says it prolongs life.

(x) The author at last does allow that acids in compounds do produce their natural effects; why will he not allow the same in animals as in fossils?

PROCESS CLII.

A solution of sulphur in a fixt alcali.

PREPARATION.

Take nine drams of flower of brimstone, melt them in a crucible, add two drams of fine alcali, it acquires a new smell and grows red; stir them about with a tobacco-pipe, pour it upon a cold marble, 'tis a red, brittle mass, soluble in water.

Its Uses.

The alcali having dissolv'd the acid, turns the sulphur into a soap; hence appears the use of fixt alcali's in metallurgy, for the acid in the sulphur makes the metal brittle; hence we may know whether any glebe contains sulphur, by mixing fixt alcali along with it, for then it gives the alcali a colour and smell.

PROCESS CLIII.

Solution of sulphur in volatile alcali.

PREPARATION.

To flowers of brimstone pour on any volatile spirit, distill and cohobate, and the sulphur is dissolv'd; if they are kept long in a shut vessel and shaken together, it gives a golden tincture.

Its

Its Uses,

Whether this be pectoral, as a great chymist says, I doubt. (y)

PROCESS CLIV.

Solution of sulphur in alcohol of wine.

PREPARATION.

To sulphur open'd by a fixt alcali pour on alcohol to five fingers height, whilst the solution is yet warm, it gives a very red and fragrant tincture, which decant, pour on fresh alcohol till it refuses to give a tincture, pour off, and leave the dregs at bottom, which are an ash-colour'd saline terrestrial matter.

Its Uses.

Hence appears the power of alkalines upon sulphurs to make them dissolve in alcohol; this is the tincture which some boast to be metallic; so I remember an *aurum potable* which was bought at a high price, made with gold mix'd with crude antimony, mix'd upon the fire with salt of tartar, the gold remain'd, but the tincture of the sulphur with antimony was obtain'd. This tincture however, tho' in the main a cheat, is good against acids, and is warming; it grows milky in liquors, but I could not discover, by *Willis's* leave, any antiphthifical virtue in it.

(y) This preparation is certainly pectoral, and, as the chymist he mentions says, is good in astmatick cases, for 'tis irritating and lubricating.

PRO-

PROCESS CLV.

Syrup of sulphur.

PREPARATION.

Take a dram of alcaliz'd sulphur, dilute it with three drams of water, it dissolves; add three or four times the quantity of sugar, or any syrup, liquorish, &c. *m.f.* syrup.

Its Uses.

This does not agree in consumptions where people cough and sweat; this shews how sulphureous bodies may be mix'd with water.

PROCESS CLVI.

A solution of sulphur in any express'd oil.

PREPARATION.

Take four pound of oil olive, heat the oil, put in 1 4th of sulphur, let them continue upon the fire till they mix, and thus you make a solution of your sulphur; this is the balsam of sulphur that heats, mollifies, and dissolves externally, and internally is prais'd against putrefactions and supurations of the kidneys, lungs, &c. but it dries too much, gives thirst, and palls the appetite; however, I advise a sparing use of it; they concluded this, because it cur'd external ulcers; it dissolves no metals except lead, 'tis therefore a menstruum for some things.

P R O-

PROCESS CLVII.

A solution of sulphur in distilled oil.

PREPARATION.

Take flower of brimstone one ounce, ethereal oil of turpentine six ounces, boil in a wooden furnace till it dissolves; decant this, pour on more oil of turpentine, boil as before, till you get all the tincture; there are crystals that remain in the pipkin, have a care of stopping the pipkin whilst it boils.

Its Uses.

This oil does not dissolve it so well as common oil, but this balsam consists of the oils of sulphur and turpentine, and the acid of sulphur; 'tis a good remedy for pains and the nerves, for sanious, fistulous ulcers; 'tis warming, diaphoretic and diuretic, it gives the urine a violent smell; this is the terebinthinate balsam of sulphur; it may be made with any other oil, oil of aniseeds, amber, juniper.

PROCESS CLVIII.

Soap or balsam of sulphur.

PREPARATION.

Take the Process of 156, proceed as in 73; or Process 157, and proceed as in 74.

Its Uses.

This shews the method of making soaps out of sulphur, but that made in 73 and 74 is not so rancid.

P R O-

PROCESS CLIX.

Balsam or soap of sulphur united with alcohol.

PREPARATION.

Put on to the balsam of sulphur terebinthinated, or its soap, five times as much alcohol; let 'em rest a while, the crystals precipitate, the sulphurs dissolve.

Their Uses.

Acids pour'd on to any sulphureous tincture, precipitate it into a white fetid powder, *e. g.* to any gold tincture pour on vinegar, and 'twill succeed.

PROCESS CLX.

The making of sulphur out of oil and acid.

PREPARATION.

Take four ounces of oil of turpentine, pour in gradually one ounce of oil of vitriol, they effervesce, grow red, and smell; digest for eight days, then distill, an oil appears, a pitchy bitumen is at bottom, distill on, you gain sulphur. (z)

Its Uses.

Hence the basis of sulphur is acid and oil intimately united; if it is burnt, one part affords acid, which is choaking, antialcaline, antiseptic, and ponderous; the other gives oil; the acid of nitre, alum, &c. join'd with oil, give a sulphur; this shews how to explain a great many arcana, *e. g.* let *sal mirabile Glauberi* flow in the fire,

(z) N. B. Boyle.

throw

throw in charcoal, you have a flame, and a red matter at bottom; dissolve in water, a true sulphureous matter appears; carefully observe therefore whether any acid be in inflammable bodies.

P R O C E S S CLXI.

The making of sulphur from alcohol and acid.

P R E P A R A T I O N.

In a glass cucurbit put eight ounces of alcohol without alcali, put in oil of vitriol, gradually shaking afterwards the heat and steam choakingly; pour in thus 1 8th of oil of vitriol, and they smell like southernwood, but the steams are choaking, the liquor becomes red, stop up the vessel, digest for five days, then distill gently, till the matter grows black, this will be very fragrant, then begins some acid to arise, change the recipient and gently distill for fear the matter rarefy, a fetid phlegm ascends; change the recipient again, a fetid liquor ascends; at the bottom remains an acid black matter, not inflammable but brittle like sulphur.

Its Uses.

Thus have we three distinct choaking liquors and sulphureous dregs; there is an effervescence 'twixt the acid and the alcohol, and a fragrant smell, but when digested the smell is like garlick. *First*, Is separated the oil of vitriol. *2dly*, A fetid, acid, watry, sulphureous, not inflammable liquor, altho' there was no water discover'd in the alcohol. *3dly*, Aromatic, limpid, ponderous liquor dissolving in spirit of wine, and then they turn yellow, which is the *oleum vitrioli dulce*; the dregs at bottom by pouring on water turn into an acid oil of vitriol, is not this *Crollius's* philosophical

cal spirit of wine, or *Paracelsus's* dulcified spirit of vitriol, which, he says, is antiepileptic, is it not the *aurum potable* of *Paracelsus* prepar'd with gold and digested in the stomach of an ostrich; this operation excites the curious, here is not sulphur but something sulphureous.

Thirdly, METALS.

PROCESS CLXII.

Vitriol of Iron.

PREPARATION.

Take oil of vitriol, one pound, drop it gradually into 8 pound of water, shake and mix, then throw in filings of iron, a strong effervescence ensues, with a garlic smell; continue to throw in this iron till no effervescence ensues, strain and filter this styptic liquor thro' cap-paper, exhale the liquor to a pellicule, put them into a cellar and you have green crystals, which we call copperas.

Its Uses.

The Iron attracts the acid; hence this is metallic salt and melts at the fire, some call it the *magisterium martis*, it melts in water, and is given internally to 12 ounces, where one pound of salt dissolv'd in 100 of water are made use of; 'tis gently cathartick and makes the stools black, kills worms, and corroborates the fibres; some have thought chalybeat waters were produc'd in this manner, but *Hoffman* has undeceiv'd us, 'tis bad in putrid fevers, because the alkaline (*y*) salts of the blood preci-

(*y*) *N. B.* He denies fixt salts in the blood, he denies volatile salts also; and says the heat to a certain degree produces them, and yet here you see he owns them!

pitate it, women who take steel have nidorous belchings, and their excrements grow black, they are good in acid constitutions; hence vitriols are made in the earth, by the acid preying on the steel (z).

P R O C E S S CLXIII.

Vitriol of Iron with Ludovicus's Tartar.

P R E P A R A T I O N.

Take one pound of vitriol of steel, four pound of cream of tartar, 20 pound of water, boil 'em and stir them, take care of burning them, put them into a glass vial, pour in common spirit of wine to four fingers height, boil 'em for an hour, when they are cold pour out the red liquor, pour more spirit of wine to the dregs, and proceed thus, till they afford no more tincture, distill this liquor till a pellicule appears, you get crystals, or if you only inspissate to a pellicule, you have the same crystals, this is call'd *Ludovicus's Tartarus Martialis*.

Its Use.

Physicians have thought steams might be readily convey'd into the blood by force of acids; add that it would be precipitated by alkalines; hence this preparation, it opens, attenuates, corroborates, stimulates, is cathartic and diuretic; hence is it good in anasarca's, scurvies, jaundices, hypochondriac and hyfteric diseases, the rickets and worms. Its dose is a dram in fix drams of water, repeating it thrice, drinking above it four ounces of whey in

(z) It so, either *Hoffman* or *Boerhaave* are mistaken, *Hoffman* says, the *acidule* are not produc'd by this union.

a morning fasting, walking so as not to sweat for nine days together; but a few drops are sufficient for children; a dram of chalybeated tartar serves for the same uses; if it moves the belly, so much the better.

PROCESS CLXIV.

The white ash-colour'd and red calx of vitriol martis.

PREPARATION.

Put half an ounce of the best sort of steel into a dry glass mortar, powder it fine, give it 150° of heat, it becomes a white calx, sweet and styptic; by 300 degrees of heat, it becomes ash-colour'd, and of an austere taste; but by an open fire, it becomes red and caustic.

Their Uses.

Thus vitriols, by calcination, lose their pel-
lucidity in water; the first calx is styptic gently, and may be mix'd with sugar for children; the second is somewhat more restraining, but both these two are soluble in water; the third is caustic for the callous lips of ulcers, and stopping fluxes externally, and is not soluble in water, the longer 'tis calcin'd, the stronger it is; wash this in water till the water becomes insipid, and you get a *crocus martis restringens*; crystallise, and you get salt of vitriol.

PROCESS CLXV.

The liquor of mars per deliquium.

PREPARATION.

Expose the colcothar aforesaid to the air, it becomes a red liquor call'd *oleum martis*.

Its Uses.

It attracts the water of the air, and is styptic.

PROCESS CLXVI.

The golden tincture of vitriolum martis.

PREPARATION.

To the red calx or colcothar pour on 20 times its quantity of spirit of salt, this digest for a month, you have a golden styptic liquor; you may repeat this operation till you get all the tincture.

Its Uses.

Here the steel is dissolv'd in the spirit of salt, which will produce a black colour, as you will see in the end of the lectures; this spirit can't dissolve all the colcothar; a few drops in sack kills the worms, and corroborates; some chymists said there was a medical gold, and call'd this tincture an *aurum potabile medicatum*, Tachenius, Valentin, &c.

P R O-

P R O C E S S CLXVII.

Iron dissolv'd in Rhenish wine.

P R E P A R A T I O N.

To two ounces of fresh filings of iron, pour on 24 ounces of *Rhenish* wine, digest them in 200° of heat in our wooden furnace for three or four days, shaking 'em often; let them stand for 24 hours, decant the black wine, 'tis styptic and atramentous; you may pour on more wine, but 'twill not be so strong.

Its Uses.

We see a gentle acid of the vegetable kind dissolves iron; 'tis strengthning and makes good blood, and is good in cold constitutions; but 'tis hurtful where the solids are too rigid, or the fluids too thin: I've often thought this was the sulphur of metals so much boasted of; 'tis better than all the *aurum potable's*; a dram of this wine mix'd with three parts of sugar, is excellent good for children and maids.

P R O C E S S CLXVIII.

Iron dissolv'd in vinegar.

P R E P A R A T I O N.

Boil an ounce of steel filings in 20 ounces of strong vinegar for 24 hours in our wooden furnace, then let them cool and settle; strain this red tincture, it tinges the glasses that hold it; we may repeat this operation with fresh vinegar, but a small quantity will be got from it.

Its Uses.

We see how easily steel is dissolv'd in acids; this tincture is styptic, corroborating, and anti-helmintic; 'tis better by sugar; how easily does iron enter the body when 'tis dissolv'd, and mix with the humors; *Lifter* says 'tis apt to breed the stone.

P R O C E S S CLXIX.

Sublimation of iron with salt-armoniac.

P R E P A R A T I O N.

Take fresh filings of steel and flowers of salt armoniac, of each four ounces, powder 'em in a mortar, a volatile smell arises; put 'em into a glass cucurbit, clap an alembick to it, lute with common glue of paste; clap to a recipient, distill with a sand-heat of 200 degrees, you get a volatile liquor; encrease the fire, you get a salt of various colours; proceed thus for six or eight hours, let all cool; take out from the receiver the golden liquor, and from the beak of the alembick the party-colour'd salt, put 'em into a vial and stop all close; if it melts 'tis call'd *oleum ferri per deliquium*, if 'tis dry the flower of iron; at the bottom of the cucurbit is a reddish matter of an austere taste, which presently runs *per deliquium*, and is an *oleum martis per deliquium*; when this is expos'd to the air it swells as if it fermented.

Its Uses.

Here is a salt armoniac, which is an acid and alcali, united with iron; this salt lifts up the iron easily, the fixt part of the iron remains behind, whilst the other mounts; hence iron is divided
into

into fixt and volatile; hence appears the volatility of salt armoniac; hence philosophers call'd it the *avis rapax*, and *aquila alba*, which unlocks metals; this resembles the *ens veneris* of Boyle; 'tis restoring, healing, opening, seminarctic, anodyne, and the dregs at bottom, united with alcohol, do give a tincture as well as the dry flowers: Those who are curious and patient, dissolve the remaining iron and salt in the air, then they coagulate and inspissate, thus they extract the virtue of the metal; hence the rule, dissolve and coagulate; can we think they will get mercury from this iron? I have not yet found it; however, salt armoniac is useful in the experiments of metals.

PROCESS CLXX.

Tricks with sulphur and iron.

PREPARATION.

Take the filings of iron and flowers of brimstone, powder them very fine in a mortar, the more the better, they grow hot and smell; then boil this fine powder in water for half an hour, pour out and strain this water; repeat this decocting, gather all the waters, inspissate, they contain a vitriol of iron. Boil eight ounces of iron and sulphur in water, make a paste, compress this strongly into a pipkin; set it aside, it begins presently to heat, send out steams, and at last flames; as soon as it has cool'd, powder the mass, boil it in water, and you get a *vitriolum martis*; put an iron rod into sulphur melted upon the fire, it will crumble, and you get a calx of iron; or put sulphur to any iron that is red-hot, and the iron melts into a calx.

Their Uses.

The acid fixes upon the metal, and in the action the sulphur is inflam'd; by fixing upon the metal it makes a vitriol; in this manner are made the acidulæ; these croci are aperient, whilst other acids fixing upon the metals are astringent. You see, my hearers, the various ways this metal is chang'd, and various changes happen upon various metals.

PROCESS CLXXI.

Lead made into calx by the steam of vinegar.

PREPARATION.

Place lead in the alembick, put it upon the cucurbit in which I place vinegar, join them, put 'em into a sand-heat, join a recipient, distill the vinegar for 12 hours, let 'em cool; the plates of lead in the alembick grow white, take off this white powder with a hare's-foot, 'tis call'd cerufs, which is insipid and without smell; the steam of the vinegar is the vinegar of lead.

Its Uses.

You see how lead is dissolv'd into a powder by vinegar, the vinegar distill'd is the true sort of lead; this operation in the air succeeds the more the air is acid; the same Process will dissolve iron and copper into a rubigo and verdigrease; this cerufs is acid and metal, and is very astringent in ulcers; this powder receiv'd into the lungs is bad in asthma's, and makes people asthmatic; if it be taken by the mouth it raises oppressions and death, as appears in those who make cerufs; you see how easily the metal changes into a calx:
Melt

Melt lead, it looks like quicksilver; from its surface you take off its calx, and thus the lead will all melt away into scum and calx, which is poisonous; by long calcination it becomes red; copper by calcination sends forth such a scum, which, according to its colour, is call'd litharge of gold or silver; the *Plumbago* is only the vein of lead, and differs not from the former, 'tis dissolv'd with the same things, and you get *sacch-saturni*, ceruss, red-lead, as well from the one as the other, they dry alike, and are poisons alike; red-lead grows heavy by the fire, whether by the acid or the fire, see *Boyle* of powders of flame.

P R O C E S S CLXXII.

The vinegar of lead.

P R E P A R A T I O N.

Boil ceruss in 20 times its quantity of distill'd vinegar, in a glass on our wooden furnace, for four hours, shaking 'em often, let 'em cool, decant; repeat this operation with fresh spirit till it becomes without sweetness; mix these styptick liquors together, 'tis call'd the vinegar of lead, or *lac virginale*, because it cures pimples; strain and distill to 1 4th, an insipid liquor comes off, the acid remains at bottom, whether we make ceruss, the lithargies, the red-lead, or the plumbago, the same effects are produc'd; boil this liquor with fresh vinegar, the insipid parts come off, and leave a saccharine acid at bottom, of the thickness of honey, call'd *oleum saturni*; the oftner we boil with fresh, the fatter is the liquor.

Its

Its Uses.

Here is a fresh manner of uniting metal to acid; this vinegar resists putrefaction, preserves bodies long uncorrupted that are immerled in it; it coagulates the humours, keeps them uncorrupted, cures pustules and red faces, makes the skin white, but brings on consumptions; this join'd with oil of roses is balsamick, much commended by surgeons. (a)

P R O C E S S CLXXIII.

Salt of lead with vinegar.

P R E P A R A T I O N.

1st, Inspissate the vinegar of lead in a glass cucurbit till it grows as thick as oil, set it in a cool place, and you have crystals which are call'd sugar of lead. 2^{dly}, Dissolve this sugar in fresh spirit of vinegar, let it settle, inspissate to the thickness of an oil, set it in a cool place, and it exactly resembles sugar, and has a sugarish taste. 3^{dly}, Repeat this operation, the liquor can hardly be dry'd, and melts like wax with a small heat; the oftener this is repeated, the more fixt is it, and the more fluxil, and the crystals look like silver, which a certain loyalist expos'd to the publick for a secret: *Phil. Trans. abridg'd*, 3 T. p. 325. 4^{thly}, When this is expos'd to heat, it melts again, and by another inspissation throwing away the fœces with a gentle fire, it looks like silver. See *Isaac Holland*.

(a) This liquor may be that which *Ruyfch* us'd to preserve his bodies in; and this mixture with the oil of roses is an *unguentum nutritum*.

Its

Its Uses.

This is sugar, salt, magistery or vitriol of lead, 'tis the metal and acid combin'd, 'tis astringent and coagulates the blood dissolv'd in water, 'tis the vinegar of litharge, good externally in inflammations; internally for hæmmorrhages, gonorrhœas and whites, but I never durst venture it, because 'tis poisonous; if the sugar of lead be distill'd you get an inflammable spirit, and at the bottom you have a glass, which carries off all metals but silver and gold.

P R O C E S S CLXXIV.

Salt of lead with spirit of nitre, or aqua fortis.

P R E P A R A T I O N.

Put one ounce of lead in small pieces, or cerufs, or litharge, or red, into a high glass, pour on 15 ounces of spirit of nitre, diluted with ten-times the quantity of water; when the effervescence is over, put them on our wooden furnace to boil for five or six hours; let them cool, decant, distill (or evaporate) to a pellicule, set them to cool and crystallise; if to this salt you pour on fresh *aqua fortis*, to dissolve it and inspissate again, you gain an oil of lead, which flows on the fire like wax; throw it into the fire, it does not flame as silver with spirit of nitre, but spits and flies about like shot, but powder'd finely it may be melted.

Its Uses.

It is more astringent than the former, it is a sweet styptick glass.

P R O-

PROCESS CLXXV.

Salt of lead treated with alcali's.

PREPARATION.

Take two ounces of salt of lead 173, 174, finely dry'd and powder'd, oil of tartar, four ounces, digest, the longer the better; then add one ounce of salt armoniac, digest again, this being done twice or thrice, dry and expose it to run; dry again, and distill from a loricated glass retort, in a sand-heat, you get waters, and at bottom somewhat much chang'd.

Its Use.

We see by this preparation the metal separated from every thing but mercury (b).

PROCESS CLXXVI.

Calx of the vitriol of lead.

PREPARATION.

Dry the salt of lead on a fire, powder it finely, put it into a pipkin plaster'd over, stir with a tobacco-pipe, you have an insipid calx.

Its Use.

This rids the salt of its acid.

(b) We see in short an experiment without head or tail, of no use.

P R O-

PROCESS CLXXVII

Balsam of lead with vegetable express'd oils.

PREPARATION.

Put lead in any shape, whether calx, litharge, &c. into a plaister'd pipkin, and twice its weight of any oil, put it on a fire, the lead melts before the oil boils; and disappears in the oil, when it boils; and makes a balsam.

Its Uses.

It strengthens the parts it is apply'd to, it makes vessels, &c. hold water; be careful by this Process, how we pronounce of the contents of bodies, for who wou'd think lead wou'd dissolve in oil?

PROCESS CLXXVIII.

Balsam of lead with distill'd vegetable oil.

PREPARATION.

Dry sugar of lead of 173, pour on this powder'd fourfold as much ethereal oil of Turpentine in a high glass, boil, the lead dissolves and the balsam is made.

Its Uses.

As in the last.

PRO-

P R O C E S S CLXXIX.

Glass of lead.

P R E P A R A T I O N.

Take two pound of red lead, and one pound of sand, powder 'em finely, put 'em in a crucible till they flow, and till they stick like glass to a tobacco-pipe, and this is a yellow, pellucid, fusible, brittle, insipid glass of lead; this passes thro' all vessels, as water thro' a sponge; it turns all metals but gold and silver into glass, some add nitre of sea-salt to make the fusion the quicker; if sugar of lead put into a crucible, gently encreasing the fire, it also turns into a yellow glass; nay lead itself long melted will turn into glass; or take red lead four pound, sea-salt decrepitated two pound, sand one pound, mix 'em well, put 'em in a crucible till all flow, the salts will be at top and the glass at bottom, all these glasses mix'd with charcoal and fus'd, become lead again.

Its Uses.

We see a ductile metal chang'd into brittle glass, and we see how 'tis reviv'd; when sulphureous parts are taken away, metals and minerals are turn'd into glass, as appears in antimony, and these sulphurs being return'd, the metal and mineral return; see *mem. ac. R.* 1709. p. 218. This glass melted with metals, makes all fly off, except gold and silver, take care of the fumes of lead, for they are poisonous.

P R O-

P R O C E S S C L X X X .

A solution of silver in spirit of nitre or aqua fortis.

P R E P A R A T I O N .

Take an ounce of granulated silver, put it into a urinal, add 2 ounces of *aqua fortis*, very strong, when they have done effervescing and the silver is dissolv'd, the liquor is pellucid and extremely caustic, decant; spirit of nitre will do as well as *aqua fortis*.

Its Uses.

Granulated silver is made with one part silver and 10 of lead, melted and pour'd into cold water, where it turns into powder; there is generally a black dreg that settles to the bottom after the solution of the silver, and this is gold; if any salt of fountains, as *Gem*, of the sea, or armoniac, be in the *aqua fortis*, it turns *aqua reg.* and will not dissolve the silver; if the liquor be green it has copper in it; one drop of this liquor burns the flesh in an instant, and is good to take off warts, small cancers, callous lips of ulcers, &c. drop the solution into waters; if there be any sea-salt in it, the silver precipitates; this caustic makes the parts black; we see silver suspended in the liquid; the taste of it is vastly bitter.

P R O C E S S C L X X X I .

Vitriol of silver.

P R E P A R A T I O N .

Pour into the aforesaid liquor a small quantity of the filings of silver, this continue to do till 'twill dissolve

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dissolve no more, set it in a coal place and you get the crystals; or if you should evaporate the liquor to 1 10th and set it in a cool place, you have the crystals; these crystals are caustic, and will burn at a touch into a black eschar.

PROCESS CXXXII.

The lunar caustic, or lapis infernalis.

PREPARATION.

Pour the former crystals into an urinal, cut at bottom, put this piece of glass boldly upon the fire; when they have done fuming, pour 'em into a conical mold made of potter's-clay; when the crystals are cold, take 'em out by breaking the molds, and dry 'em on paper; this is the caustic stone.

Its Uses.

This is the strongest part of the acid, join'd to the silver, for the water fumes off; this will dissolve in water; add a little filings of copper to it, and you may recover the silver; 'tis a most powerful caustic and takes off fungus's the best of any, 'tis the strongest of poisons.

PROCESS CLXXXIII.

Angelus sala, or Boyle's Hydragogue of silver.

PREPARATION.

Dissolve an ounce of nitre in water, then take the crystals of silver of 181, No. 1. one ounce, dilute this in three parts of water, mix these liquors together; put these in an urinal, upon a clear fire,

fire, exhale to a pellicule, set 'em in a cool place to crySTALLISE, dry this mass gently; then take the hollow part of an urinal cut off at bottom, put these crystals in it, let 'em dry before the fire, stirring 'em that all may be equally heated, do this till no more steam arises.

Its Uses.

This is a purging silver; if you would discover a fraud some use, to wit, by pouring this nitre on equal parts of melted lead, and so making you believe that they converted the lead into a 10th part silver, put in copper, all the silver precipitates; powder the mass, 'tis bitter and somewhat caustick, two grains of it in paste with sugar purge strongly; it kills worms of all kinds, dropsies, inveterate ulcers; *Rob* of juniper-berries corrects it; have a care how you dose it.

P R O C E S S CLXXXIV.

Burning silver.

P R E P A R A T I O N.

Take a *Holland's* turf that is so much on fire as it does not smoke, place this horizontally, make a hollow in the middle of it, put on a little of the *lapis infernalis*, and it will flame and sparkle, the silver is left at bottom.

Its Uses.

Thus we see that the acids are banish'd and the metal returns; thus we see silver may be made potable; thus also we see that the nitre is still inflammable. (c)

(c) Spirit of nitre itself is not inflammable, but if mix'd with any oily body 'twill presently flame; therefore the nitre must have acquir'd some fine sulphureous parts from the silver.

PROCESS CLXXXV.

The reduction of silver from spirit of nitre.

PREPARATION.

Put into silver dissolv'd in spirit of nitre and that diluted well with distill'd water, 20 times its quantity of plates of brass well polish'd; these plates will attract the acid, a powder will subside, and the water will grow green, the shining powder is the silver.

Its Uses.

This is a ready way of pulverising silver, and it presently makes an amalgam with quicksilver; melt this powder in a crucible and the silver returns; if you view this liquor with a microscope, you see the globules of silver, pointed with the acid, run to the copper; hence copper attracts the acid stronger than the silver, hence this powder is made.

PROCESS CLXXXVI.

Luna Cornea.

PREPARATION.

1st, To the solution in Process 181, N^o. 1. dissolv'd in four times its quantity of pure water, drop in a little lime, the liquor grows immediately whitish and thick, without any effervescence; when the liquor is no more disturb'd with lime, pour it off, and gather the white thickish matter at bottom; to this matter thus precipitated pour in hot water till it grows insipid, then boil this matter in water, shake the glass, then filter it, dry it upon the filter; this is the calx of silver. 2^{dly},
Melt

Melt this in a crucible, pour it upon a marble, 'tis a shining, brown, brittle, and somewhat tenacious matter, hence 'tis call'd *Cornea*; 'tis silver united to the spirit of nitre and sea-salt; if you endeavour to expel the spirits upon the fire, great part of it flies off, nor does the remainder turn into silver: If one p. of silver, calcin'd by 185th Process, mix'd with two p. of sublimate mercury, distill from a retort in a sand-heat, and the *Luna Cornea* is at bottom; or if instead of salt you use its spirit, or also if you precipitate the silver with oil of vitriol, in either case you will have the *Luna Cornea*.

Its Uses.

We see how the salt precipitates the silver, for salt with spirit of nitre makes an *aqua regia*, therefore it lets go the silver; if with two p. of the calx of silver you mix one p. of regulus of antimony, and mix 'em well, putting 'em into a retort and distilling from a sand-heat, you get the butter of antimony, and the silver remains at bottom with part of the regulus, and being reduc'd always gives true gold (*d*); hence we are certain that the weight which accrues to the calx of silver, is owing to the *aqua regia*; who would believe so insipid a body as *Luna Cornea* contain'd one fifth of a most corrosive acid? (*e*) how does *sal-marine* act upon metals, and yet is return'd? hence 'tis plain how gold may be discover'd in bodies it was not suppos'd to be in: How did *Homberg*, by the assistance of tartar, quick lime,

(*d*) That is, the acid joins in with the sulphur of *antimony* and gives a butter; whilst the *aqua regia* dissolves the gold in *It* and precipitates the silver.

(*e*) No more wonder, than that so cool a body as nitre contains so corroding a spirit,

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salt-armoniac, and the white of an egg, draw out of half a pound of silver three drams and 50 grains of true quicksilver? this *Luna Cornea* is not dissolv'd in *aqua regia*, *aqua fortis*, nor the fire.

P R O C E S S CLXXXVII.

Tin dissolv'd in aqua regia.

P R E P A R A T I O N.

Put *aqua regia* in an urinal, throw in pieces of tin till all is dissolv'd, and the commotion is over; dilute this with 20 times as much water, the tin precipitates, wash it with warm water, and this white powder is call'd the magistery of tin: Tin dissolv'd in *aqua fortis* effervesces, and makes a sort of soap, like the white of an egg. The magistery spokc of is good in hysteric and hypochondriac cases, but there are safer things; mix'd up with pomatum 'tis an excellent cosmetic; this magistery is hardly meltable into tin again: Tin requires the least quantity of acid to dissolve it of all other metals; tin thus dissolv'd does not smoke, but mix this calx with twice as much mercury sublimate and distill from a retort, the liquor that comes forth always smokes.

P R O C E S S CLXXXVIII.

A solution of copper in distill'd vinegar.

P R E P A R A T I O N.

If you put copper plates at the top of an alembick, and heat 'em, as was said above, on lead, the metal will be thus dissolv'd, and the liquor distill'd and thicken'd by the fire becomes green,
one

one drop of which is emetick the plates being dried, a verdigrease, which is commonly made at *Montpelier*, by the rasins press'd on copper plates; if you boil verdigrease in spirit of vinegar till it refuses any more to be ting'd, a great deal of indissolveable matter remains at bottom, which shews the brass corroded is not verdigrease; if you inspissate too much, the crystals grow black.

Its Uses.

This shews how copper is dissolv'd with acids; copper easily grows green by acids; these crystals are emetic, cathartic, and cathartic in ulcers.

PROCESS CLXXXIX.

A solution of copper in salt armoniac.

PREPARATION.

To one pound of the filings of copper add three pound of salt armoniac, and pour on four pound of clear water, mix 'em together; dry this part in a glass cucurbit cut off in a moderate fire; repeat this solution and exsiccation often, then boil in water, strain, inspissate, you have a blue tincture, and you may crystallise.

Its Uses.

This is a famous antiepileptic liquor for children, a few drops given in mead fasting, it purges 'em gently, kills worms.

PROCESS CXC.

A solution of copper in aqua fortis.

PREPARATION.

Pour on *aqua fortis* or spirit of nitre to filings of copper, an effervescence follows, and the liquor grows green; do this till it grows no longer green, strain, and inspissate to half.

Its Uses.

The least quantity of this is emetic, kills all insects, as fleas and all sorts of lice, &c.

PROCESS CXCI.

A solution of copper in aqua regia.

PREPARATION.

Proceed as in the last.

Its Uses.

Observation alone shews what will, and what will not dissolve.

PROCESS CXCI.

A solution of copper in volatile alkali.

PREPARATION.

To one dram of filings of copper put 12 of spirit of salt armoniac, shake 'em often, you have a fine blue tincture; or if you moisten the filings with oil of tartar three p. digest, dry, boil, strain, and inspissate, you have the same liquor,

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Its Uses.

The dose is from three, doubling the dose every day, to 24 drops, in mead, and continue in this last dose for some days; 'tis a good aperient, attenuant, warming, and most diuretic liquor: I cur'd a confirm'd ascites by this, the water flow'd as from a cock, but fail'd in another, which shews the fallibility of methods; 'tis good in cold diseases: Copper is easily dissolv'd in any acid, even in express'd and distill'd oils it gives a greenness.

P R O C E S S CXCIH.

The depuration of mercury.

P R E P A R A T I O N.

Strain mercury thro' leather, and whatever is faculent is left behind; or distill mercury from a retort in a sand-heat into a recipient where there is water; or distill it with quick-lime from a retort on a sand-heat.

Its Uses.

These are the common methods of purifying quicksilver, and you see by this how volatile 'tis.

P R O C E S S CXCIV.

A solution of quicksilver in aqua fortis.

P R E P A R A T I O N.

Take four ounces of pure quicksilver, put it into an urinal with six ounces of *aqua fortis*; put 'em upon the fire till the mercury is dissolv'd,
m 4 the

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the liquor is pellucid and the taste horridly austere; thus we see a body so much more ponderous than *aqua fortis* is yet to be dissolv'd in it; the quicksilver is only divided, not chang'd, so that in every drop of the liquor there is a proportion of the mercury; this solution is intractably caustic; hence it takes off warts, it makes the skin purple; *aqua regia* and spirit of salt do not readily dissolve quicksilver; yet mercury sublimate is a true salt of mercury dissolv'd by these spirits, and pour on salt of tartar to sublimate water, you regain a sea-salt; the precipitate may be dissolv'd in *aqua regia*, 'tis sublim'd only by sea-salt into a mercurial salt.

PROCESS CXCV.

Vitriol of quicksilver.

PREPARATION.

First, when you have dissolv'd so much quicksilver in *aqua fortis* as it will dissolve no more, then it precipitates white at bottom; pour off this liquor, and a most intractable acrimonious salt, soluble in water, remains at bottom; if the remaining liquor be inspissated to half and set to cool, you have crystals; but if you take one part of quicksilver, two pound of salt decrepitated, and powder them finely, put 'em into a glass cucurbit and give a strong fire, you get mercury sublimate, which is a true vitriol.

Its Uses.

Quicksilver is made an imperfect vitriol by spirit of nitre, as well as a fixt one; whereas by spirit of salt 'tis a perfect and volatile one; its acrimony is from the spirit of salt.

P R O-

PROCESS CXCVI.

White precipitate mercury.

PREPARATION.

Pour on to the solution of mercury in spirit of nitre two pound of water, to this pour on brine till no more white powder will precipitate; decant the liquor, and filter the powder till 'tis dry, wash this with warm water frequently till 'tis tasteless.

Its Uses.

The salt water and the spirit of nitre make an *aqua regia*, and as mercury is not easily dissolv'd in this, it falls down. This powder is an acid and quicksilver united; it may be given internally, and being powder'd with sugar it makes a panacea, which given to nine grains fasting in adults it vomits, purges, kills the worms, and so cures scabs, venereal ulcers, and a gonorrhœa; this dose often repeated raises a salivation; mix'd with pomatum it cures ulcers and scabs; if you calcine it upon the fire in a glass, it neither vomits, purges, nor salivates, but proves diaphoretic and alterative; rub this powder upon brass, it silvers it.

PROCESS CXCVII.

Red precipitate mercury.

PREPARATION.

1st, Take the solution of mercury in 194, a pound and half, put it in a large glass retort, fit a recipient, distill with a gentle fire from our wooden

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wooden furnace so that the liquor never boil, at bottom you have a dry, white, most corroding matter, at the sides of the retort somewhat red; then place the retort in a sand-heat, fit to it a large recipient, distill gently till red fumes appear; change your recipient, fit another, distill till all the red spirit of nitre is come out; at the bottom of the retort will be the red powder, and a parti-colour'd one all about the retort, keep the red one apart. 3^{dly}, Chymists have repeated this work in hopes of finding gold: *Paracelsus* advises it, and *Sylvius* in his posthumous works affirms it.

Its Uses.

This is *Vigo's* red precipitate, which is corroding, and produces eschars; 'tis dangerous to give it internally, because it vomits, and corrodes the bowels; three grains, however, are as much as can be given; it may be made milder by firing alcohol upon it, or distilling it with the whites of eggs or vinegar, but to what purpose? when we have the white precipitate, which is milder; by calcining it in a glass over the fire, it becomes so mild as hardly to act: Let mercury be prepar'd any how with acids, add quick lime, distill, you regain the mercury.

P R O C E S S CXC.

Mercury sublimate.

P R E P A R A T I O N.

Inspissate the solution of 194 into a dry white mass, take this powder and add 10 p. of decrepitated salt, and as much of vitriol calcin'd to a whiteness; powder all these well apart, then mix 'em, put 'em into a glass vial, fill it 1/3 full, put it

it into a sand-heat, give a gentle fire, take care of the fumes, then close up the glass with paper, encrease the fire, and you have the white crytals, which separate.

Its Uses.

This mercury has *aqua fortis* in it, 'tis a true vitriol of quicksilver, 'tis very corrosive, and makes an eschar; it consumes callus's, ulcers, warts, and indurated glands; it makes up *Vigo's* troches of minium; a grain of it in an ounce of water is a cosmetic; it kills all insects; it may be given internally, mix'd with syrup of violets, but be very wary what you do; by the assistance of it and silver, some gold may be found; see Process 186. We see how *aqua regia* dissolves mercury when it has first been dissolv'd in *aqua fortis*, how spirit of salt makes it volatile when nitre had fix'd it.

PROCESS CXCIX.

Turbith of mercury.

PREPARATION.

1st, To four ounces of quicksilver, put into an urinal eight ounces of oil of vitriol; put 'em upon the fire, being warm'd put it upon live coals, and boil 'em till the whole mercury is dissolv'd into a white mass and dry; take care of the steams. 2^{dly}, Powder this finely in a glass mortar, throw it into 20 times its quantity of warm water in a glass, it presently grows yellow, shake it often, then let it settle, decant, wash the remaining powder in warm water often; this is call'd *Turbith mineral*. 3^{dly}, Let this liquor decanted be strain'd, and inspissate to 1 6th; this is *mercurial*

mercurial water, and by adding oil of tartar you get a red precipitate.

Its Uses.

You see how the variety of acids changes the colours of the mercury; if this white powder be expos'd to the air, it grows of a citron colour; and 'tis that powder which *Paracelsus* did wonders with; burning spirit of wine upon them, it mitigates it; *Sydenham* commends it highly in the pox; *Boyle* says it dissolves catarracts, 'tis good in dropfies; *Helmont* means this when he advises *Vigo's* powder to be prepar'd with the fire vitriol of *Venus*, by which he means oil of vitriol; distill the white of an egg from this powder, it renders it milder: Metals act upon us by their powders, bulk, and figure; and salts making 'em vitriols, cause 'em to act violently, calcination taking off those salts, abates their force; the manner of taking off these acids is by washing with water, by distilling to a driness, by kindling spirit of wine upon them, or distilling it from them, by mixing more metal with 'em, as in the preparation of *Mercurius dulcis*, by alkaline salts, by testaceous powders, and by calcination with a strong fire.

P R O C E S S C C.

The fiery oil of mercury.

P R E P A R A T I O N.

To the last preparation, I mean the white powder, pour on equal quantities of oil of vitriol, boil to a driness, avoiding the fumes; when 'tis dry pour on more oil of vitriol, till it will dry no more, but stands like an oil.

Its

Its Uses.

This is the inceration and saturation of metals^d you may regain the mercury from this by distilling from the filings of iron.

PROCESS CCI.

Æthiops mineral.

PREPARATION.

Take one dram of flowers of sulphur, three drams of mercury, rub 'em well in a mortar till the mercury disappears, and you get a black mass.

Its Uses.

We see how easily sulphur unites with mercury; this powder never enters the lacteals, it raises no salivation because it never enters the blood; it kills the worms in the bowels, and I don't think it safe for children. (e)

PROCESS CCII.

Fætiticus Cinnabar.

PREPARATION.

Take flowers of sulphur, four ounces, let it melt on the fire, then take quicksilver warm'd, put it into the sulphur, stirring it about, 12 ounces; you have then a black mass, the matter be-

(e) That it does not enter the blood, or that it has appear'd in ulcers in its proper shape, are two assertions equally true; but that it will not salivate, especially as 'tis here made, is a mistake that every common practitioner can contradict with truth,

ing

ing set on fire, put this into a retort, lute a recipient, distill from a sand-heat, encreasing the fire to the last degree. 1st, An insipid water arises, then white flowers, then somewhat black, let all cool; this black by powdering becomes a cinnabar; at the bottom of the retort there remains some feculency, this cinnabar don't differ from *Æthiops*, 'tis *Crato's* great antiepileptic; I have never seen many good effects from it; if join'd with cathartics, it passes the bowels, mix'd with pomatum 'tis a red cosmetic, it has been us'd for ulcers in the nose and mouths of venereal persons with little or bad success, the mercury may be recover'd by mixing it with iron filings and calling it over the helm.

P R O C E S S C C I I I .

An amalgam of mercury with lead and other metals.

P R E P A R A T I O N .

Melt lead in an iron spoon, put to it an equal quantity of quicksilver warm'd, stir 'em and it becomes a hard mass like silver, but by rubbing grows soft; put this mass into a glass mortar, rub it fine, add as much mercury as you please, it will mix with water like salt; tin may be managed in the same manner in every respect; if also to copper dissolv'd in *aqua fortis* and diluted with 12 times its quantity of water, and to this liquor heated, you put in plates of iron finely polish'd, the copper precipitates, wash this precipitate with warm water till it grows insipid; to this powder well dried, put mercury, equal p. and you have an amalgam, which by adding more mercury will also dissolve in water like salt; 'tis a difficult matter,

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ter to make salt amalgamate any other way. 4. Silver will amalgamate after this manner. 5. Dissolve gold in *aqua regia* till it will dissolve no more, dilute this with 12 times its quantity of water, throw into it plates of copper well polish'd, keep it in a proper warmth till all is settled, pour off the liquor, wash the powder, dry it, mix it in a glass mortar with quicksilver; this is an amalgam which also can be dissolv'd in water; or make from gold and silver depurated by lead a separation of the silver by *aqua fortis*, the gold settles black at the bottom, this black powder being dried, mix'd with silver, makes an amalgam.

Its Uses.

All amalgams are white, by these methods you may make amalgams from every metal but iron; hence we see mercury dissolves metals, this amalgam is a good way to hide metals, tho' the deceit is easily found; the first fumes of lead coagulate mercury, the mercury easily ascends and leaves all metals behind it, the use of these amalgams is for silvering and gilding.

P R O C E S S CCIV.

The ablution of metals by mercury.

P R E P A R A T I O N.

Take any amalgam, rub it well in a mortar, pour on water, it grows black; pour on and off the water in this manner till the amalgam looks as white as silver, this black powder is neither metal nor mercury.

Its

Its Uses.

What this powder is, I hope to speak of hereafter.

P R O C E S S C C V .

Solution of gold.

P R E P A R A T I O N .

Take *aqua regia*, pour into it one p. of pure gold, put 'em upon the fire in an urinal, that the gold may dissolve; put in so much as the spirit will dissolve, the liquor becomes of a golden colour; if any black subsides to the bottom, 'tis silver.

Its Uses.

This is a caustic liquor, it dyes the skin purple, 'tis a poison; put in any fixt or volatile salt, the gold falls to the bottom, decant and wash this powder with water, dry with a heat of 80° ; this powder is heavier than the gold put in; put the powder in any thing upon the fire, it flies off with a crack, and is call'd *Aurum fulminans*, which I don't know how to explain, some have sav'd this powder by letting it explode in a glass bell, notwithstanding the great promises from the use of this powder, it raises violent pains.

Fourthly,

Fourthly, on SEMIMETALS.

First, on SALINES.

PROCESS CCVI.

The analysis of vitriol into spirit, oil, and colcothar.

PREPARATION.

First, Take eight pounds of green vitriol, put 'em into earthen jugs, place 'em on a fire till all the steams go off, and the matter grow red, thus is the vitriol calcin'd; the Jugs will be broke; powder this calcin'd matter, of which you have lost three pounds, put it into an earthen retort, fix a recipient to it, lute it with marl and lime, let the lute dry, observe all the cautions in 141, 144; continue the fire for six hours, continue distilling till the retort is red hot, 18 hours are sufficient; then carefully take off, when all is cool, the recipient with the oil in it; from this quantity I generally have 21 of oil; in the retort there was 52 ounces of colcothar, so that five ounces were lost. (f)

Its Uses.

Thus we have the oil and spirit of vitriol of great use in physick, the oil does not boil unless in 600 degrees of heat, and it parts with its spirit and water in 590°, and becomes most ponderous

(f) *N. B.* The author does not immediately join the recipient and the retort, but uses a cylindrical tube, one part of which he unites to the recipient, the other to the retort with his lute.

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and fiery, and put into water it effervesces strongly; if you distill this oil from a sand heat, so that the drops follow one another in 6 seconds, and, receiv'd into water, you have a pure oil, every drop that falls into the water makes it hiss like fire, and if it falls upon glass, when hot, it splits it like a diamond; take your fire down, melt your glass, or you may rectify it upon its fæces.

P R O C E S S CCVII.

Ens veneris.

P R E P A R A T I O N.

Boil colcothar in water, strain it, it has the taste of vitriol, boil and strain so long as it tastes vitriolic, keep the calx. 2dly, Take this calx and flowers of salt armoniac dry'd, mix 'em well in a mortar, take care they don't grow moist, put 'em into a cucurbit, fit to it an alembic, first comes off a volatile yellow liquor, encreasing the fire, you have the *ens veneris*, yellow; let all cool, and take off this powder, at bottom will be found a red matter, which will swell in the air (g).

Its Uses.

You see how metals will be elevated with salts, a grain of this put into the infusion of galls turns black, Boyle commends it highly for the rickets and other diseases.

(g) See Process 169. which is the same

Secondly,

Secondly, SULPHUREOUS SEMI-METALS.

PROCESS CCVIII.

Solution of antimony in aqua regia.

PREPARATION.

Powder fine antimony a pound, pour to it of *aqua regia* ℥jss, as they effervesce greatly, take care of the steams, at bottom is found an ash-colour'd yellowish matter, which dries.

Its Uses.

This is a moist calcination of antimony, thus antimony acquires most virulent properties; this puls is the sulphur of the antimony, so that the *aqua regia* calcines and also separates the *regulus*.

PROCESS CCIX.

True sulphur of antimony.

PREPARATION.

Take the calx of 208; wash it in water, shake it; pour it off and keep it apart; dry the powder at bottom, it has every mark of sulphur, but if you had put in a great quantity of *aqua regia*, the sulphur would become more visible.

Its Uses.

We see how sulphur lurks in metals and metallicks, and how the *aqua regia* secretes out the metal; this sulphur differs only from the common in as much as 'tis green.

P R O C E S S CCX.

Glass of antimony.

P R E P A R A T I O N.

First, Take antimony in fine powder 2 pound, put it into an unglaz'd pipkin, set it on the fire and calcine till it smoaks no more, take care of the steams. *2dly*, Put this calx into a crucible, cover the crucible with a brick, encrease the fire till all is melted, keep it in this condition for a quarter of an hour; pour it upon a marble and let it cool.

Its Uses.

We see by Process 209, that antimony has a sulphur, and by this Process that it has a metallic substance, which is emetick. I know not why, only that by frequent infusions in wine, it loses its weight, this glass as lead consumes all metals, except gold, whose colour it heightens.

P R O.

P R O C E S S C C X I.

Regulus of antimony with salts.

P R E P A R A T I O N.

First, this is done by bare fusion, the sulphur is at top, and the metallic parts settle at bottom. *2dly*, Put two pound of nitre, three pound of tartar, and four pound of antimony, powdering them well, into a large crucible, gradually, so that one pound be thoroughly detonated before the other is put in; when all is done, let it continue till it flow like water; then presently put it into a metallic cone greas'd with candle-grease, you have at the top a sulphureous scum, and at bottom the regulus, streak'd like a star; the crucible must be large, a little must be thrown in; throw none in till the other is perfectly fix'd; without these cautions it will not do.

Its Uses.

By the laws of *Hydrostatics*, the heavier part subsides; here is the art of separating sulphur from the metal, so it is in other metals; the alcali's join with the sulphur, and the metal is set free at bottom; the alchymists are in admiration of this star, if you melt it afresh with alcali's, you have fresh sulphureous scum, neither do I know, whether it ever can be free of sulphur; the scum then is sulphur and alcali; hence may we understand its virtues, 'tis emetic as the glass is; we see how alcali's depurate metals.

P R O C E S S C C X I I .

Regulus of antimony with iron and nitre.

P R E P A R A T I O N .

Take lbss of the filings of iron, heat 'em in a crucible, put in finely powder'd and dried antimony ℥j , keep 'em in the fire till they flow, then throw in gradually a quarter of a pound of nitre, keep 'em there till they flow like water; pour it out as before, you have the regulus, and the scum at top, which is harder than that before-mention'd.

Their Uses.

We see how the iron also attracts the sulphur; *Paracelsus* and *Alexander Scutbten* speak of this preparation.

P R O C E S S C C X I I I .

The alchymistical regulus of antimony.

P R E P A R A T I O N .

Put into a crucible iron nails eight ounces, place them in a wind furnace; when they are fully set on fire throw in a pound of antimony finely powder'd, stir 'em about with a tobacco-pipe till the iron is melted, then throw in three ounces of nitre gradually, which must be very dry; when the detonation is over, let 'em stand till they run like water, pour it out, as before, you have eight ounces six drams of regulus, 11 ounces of scoriæ, therefore four ounces and two drams are lost in steam. 2. Put this regulus again into a crucible, when

when 'tis melted throw in three ounces of finely powder'd antimony, when all is melted throw in three ounces of nitre gradually, as before, keep 'em five minutes in fusion, pour 'em into a cone, you have 10 ounces six drams of regulus. 3. Put this regulus again into a crucible, melt it, throw in three ounces gradually of nitre powder'd, let 'em flow, pour 'em out into a cone, as before, you have nine ounces of regulus like silver, two ounces of scorix and seven drams, you have lost one ounce and five drams. 4. Put this regulus again into a crucible, melt it, pour in nitre three ounces gradually, let 'em flow for an hour, then you have seven ounces three drams of fine regulus like silver, and starry, two ounces seven drams of golden fiery tasted scorix. 5. The crucibles ought to be very large, the fire equally continued, the cones moderately warm, and anointed with candle-grease.

Its Uses.

Thus we observe that iron melts with antimony as other metals do with lead; the iron unites with the scorix, and the mercurial parts of the antimony settle to the bottom; the nitre agitates these sulphurs, and the regulus settles; the scorix has peculiar virtues, and swells in the air; the second and third fusion shew the metallic parts the better, and communicate an acrimonious taste to the scorix: See *Paracelsus, Scuchten, Philaletha, Pantavion, Becher, and Stahl*. The regulus gives its colour to the gold; this regulus vomits, and the scorix communicate a tincture to alcohol. I ought to blush at the pains I have taken with antimony, but every one to his taste.

PROCESS CCXIV.

The golden sulphur of antimony.

PREPARATION.

Boil the scorix of 212 in water till they be dissolv'd, pour on vinegar till no more is precipitated, let it settle, and decant; this precipitation raises a stinking smell; this golden sulphur must be often wash'd in water till it be nearly insipid; 'tis emetic.

PROCESS CCXV.

Crocus of antimony.

PREPARATION.

Take equal parts of antimony and nitre, powder 'em fine, and heat them in an iron spoon, throw all gradually into a crucible, heat it till all is detonated, wash this whole matter with water, filter those waters, put on a little vinegar and the powder settles; thus you have a crocus: They deflagrate like gunpowder; the metallic part may be calcin'd into glass and scorix, and is violently emetic, as in Process 210.

PROCESS CCXVI.

A milder emetic of antimony.

PREPARATION.

Take antimony 1 p. nitre 2 p. powder them, throw 'em into a crucible, red-hot, let 'em detonate,

tonate, wash 'em, and you have an insipid antimony, the water is salt; this gently moves vomiting; the water precipitates white with vinegar.

PROCESS CCXVII.

Diaphoretic antimony nitrated.

PREPARATION.

Take antimony 1 p. nitre 3 p. powder them, throw them gradually into a red-hot crucible, taking care to let the last be heated before you throw in more; let them cool, you have a white powder.

Its Uses.

It raises no nausea, and may be safely taken to half a dram in acute cases; 'tis worse for washing, because we take off the nitre; antimony of itself is not emetic, nitre in equal parts makes it vomit; washing therefore makes it worse, by taking off part of what fixes it: Chymists repute it opening and diaphoretick, and that the arsenical poison of it is fix'd by the nitre; but before this fixing there was nothing emetic in antimony, but what the nitre made; hence *B. Valentine* would not be solicitous to get rid of the fixing nitre, for it does not nauseate but stimulate. (b)

(b) *N.B.* We can make antimony into sulphur; it fixes quicksilver, and makes æthiops as sulphur does; this sulphur may be made active, and it may be curb'd, as the operator judges most proper; the chymist must only adjust the salt.

PROCESS CCXVIII.

Common diaphoretic antimony.

PREPARATION.

If to the last Process finely powder'd you pour on boiling water, you clear the calx of the nitre.

Its Use.

I advise it only with purgatives, as in *pulv. Cornachinus*.

PROCESS CCXIX.

Nitre sibiatiated.

PREPARATION.

Exhale the water in the last preparation, perpetually stirring it, you have a white saline matter.

Its Uses.

This salt opens gently, is diaphoretic, diuretic, cooling, and of good use in the small-pox, measles, and inflammation of the lungs.

PROCESS CCXX.

The fixt sulphur of antimony.

PREPARATION.

To the nitrous liquor of 218 boiling hot, pour in spirit of vinegar, it grows milky; continue to do this till no more settles; decant the liquor and

and dry the powder; the acid precipitates the sulphur which the spirit of nitre had dissolv'd, without an effervescence.

Its Uses.

I believe 'tis of no use, but the vinegar along with the powder is antipestilential: Chymists are too profuse in the praise of all their preparations; however, this acetous, nitrous liquor is very useful in all febrile cases.

P R O C E S S CCXXI.

The distillation of antimony into butter and cinnabar.

P R E P A R A T I O N.

Powder two pound of sublimate very fine in a glass mortar, powder also a pound of the best antimony apart, mix them in a mortar, they grow hot; put them into a retort of a large bore, take care nothing stick to the neck of the retort; place them on a sand-heat, fit a glass recipient, cover the retort with sand, lute the recipient, encrease the fire by degrees; first comes over a liquor; encrease your fire, then comes a fatty, and gradually an icy matter; apply a live coal at a distance from the neck of the retort, and the butter melts into the recipient; when no more ascends remove this recipient, which stop up, carefully avoiding the steams; clap another recipient, and then comes up a reddish matter by encreasing the fire; take away the recipient, and in the neck of the retort is the cinnabar; the retort contains the dregs of antimony; the fumes of this are caustic and dangerous for the lungs.

Its

Its Uses.

This butter is the acid that fixes upon the fine oil of the antimony, and the cinnabar is the mercury and the sulphur of it join'd together; this butter melts in heat, grows icy in cold, and precipitates in water into *mercurius vite*; if we had taken the regulus, we should have had the same phenomena, as to the butter; but then the mercury would run, because the gross sulphur is wanting.

P R O C E S S CCXXII.

Distillation of the butter of antimony into a liquid oil.

P R E P A R A T I O N.

Redistill this butter, you gain this oil, which grows more liquid by a third distillation; this oil is very caustic, and its steams are destructive; I knew an ingenious gentleman destroy'd by 'em: This experiment shews how to turn metals into a liquid oil, shews the power of sea-salt to make metals volatile, &c. (i)

(i) This is no more than what happens to all oils whatever, for the more they are expos'd to the fire, the thinner they grow, as in oil of wax, &c. the reguline part is divided so minutely by the fire, that 'tis suspended in every oil.

P R O-

P R O C E S S CCXXIII.

Mercurius vitæ and its regulus.

P R E P A R A T I O N.

Drop butter or oil of antimony into water, it turns immediately into a white powder; wash this till 'tis insipid, dry it.

Its Uses.

The salts that held the regulus are attracted by the water, so that the powder settles; some have call'd this *mercurius mortis*; 'tis a violent emetic, given to two or three grains; 'tis said this powder put into a glass, and put on the fire and continually stirring it, loses all its virulency, and is *Riverius's* arcanum; this powder has nothing of mercury in it: I took this powder prepar'd by myself to 11 ounces, put it in a crucible, it melted as soon as the fire had thoroughly heated the crucible; I had 10 ounces of regulus a little ash-colour'd.

P R O C E S S CCXXIV.

The philosophical spirit of vitriol.

P R E P A R A T I O N.

Inspissate the water of the former preparation to one half, and you have this spirit.

Its Uses.

This is ill nam'd spirit of vitriol, for 'tis nothing but the spirit of salt reviv'd from the butter and the regulus: I distill'd this water, first I
got

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got the water pure ; then mounted somewhat sub-
acid ; and, lastly, the true spirit of salt.

P R O C E S S CCXXV.

Helmont's *flowers of antimony*.

P R E P A R A T I O N.

Take a pound of stibium dissolv'd in *aqua regia* as in 208 ; put it into a wide mouth'd glass upon the fire, continually stirring it till it be dry ; powder this in a glass mortar with a glass pestle, then add equal quantities of dry salt armoniac ; then powder them exactly, put 'em into a low broad-neck'd cucurbit, fit to it an alembic, lute with flower of linseed, place it upon a sand furnace, cover the cucurbit with sand to the very neck of the alembic, give a gentle fire, you have an acid water, then encrease your fire, so much as you can bear to touch the head of the alembic ; then come up the flowers, let 'em cool, take off the alembic, avoiding the steams ; take off the flowers, put 'em into a warm glass, they are highly emetic ; the fœces at bottom may be mix'd with fresh salt armoniac, and proceed as before. 2dly, Put these flowers in water, the water grows milky, and when it subsides, the water tastes salt and armoniacal ; wash these flowers and dry 'em by the fire, they are a red emetic powder, you may regain the salt armoniac, by evaporating the water.

Its Uses.

Thus we see the death and revival of antimony, thus all pigments are made, but be of what colour they will, they are all emetic.

P R O :

P R O C E S S CCXXVI.

Helmont's fixt and diaphoretic flowers of antimony.

P R E P A R A T I O N.

Take the flowers of the former Process one pound, nitre three pound, powder 'em in a glats mortar, throw this gradually into a red-hot crucible, when the detonation is over, throw in more till the whole quantity is thrown in, let 'em cool, take out this palish yellow matter, powder it, wash it with water, 'tis a white powder; fire alcohol upon it, 36 grains of it raises sweats in fevers.

Its Uses.

Thus have we a method of fixing a volatile substance; but I have not found the effects *Helmont* boasts off.

P R O C E S S CCXXVII.

A purgative Diaceltateffon of Helmont from the fine flowers of antimony.

P R E P A R A T I O N.

Take 18 grains of the powder in the former Process, 16 grains of resin of scammony, seven grains of cream of tartar; make a powder, or take nine grains of the former powder, nine grains of resin of scammony, three grains of cream of tartar, this is *Helmont's* diaceltateffon; the first is the greatest, the last the least dose; an acid stops its operation, therefore give it with no acid, give it before the fit of an ague, it cures quartans

tans before the fourth dose as well as continual and intermittent fevers. See *Helmont*.

Its Uses.

Helmont says, it cures the gout and fevers radically, as also ulcers of the larynx, bladder and œsophagus, that it purges the body no longer than 'tis not found, the *Latin* edition says, that eight grains are sufficient; I have given it my self, and observ'd that it works well, but have always suspected *Helmont's* sincerity.

Thus have I finish'd my Processes and have discharg'd my duty, I will only recapitulate some things observable, and of use to physick and natural philosophy, drawn from the aforesaid operations.

The End of the PROCESSES.

Chy-

*Chymical Solution.*

1st, **I**T is done by water, dilution, infusion, decoction, distillation, mixtion, fermenting, putrefaction, and by separating.

2^{dly}, With the help of oil, by dilution, infusion, decoction, distillation, mixing, separation; but not by fermentation, nor putrefaction.

3^{dly}, With the fire, by calcining, burning, fusion, sublimation, mixing, separation, and helping the actions of other bodies.

4^{thly}, With air, by fermenting, putrefying, agitation, adding other parts able to dissolve.

5^{thly}, By means of fermented spirits, by dilution, infusion, decoction, distillation, mixing, making the oils thinner and more liquid.

6^{thly}, With alcalious salts, by calcining, burning, fusion, mixing, separating, according to the various strength of the fire.

7^{thly}, With volatile alcali's, subliming 'em together the dry way, by diluting, digesting, and distilling the moist way.

8^{thly}, With fixt alcali's, by the means of fire and water, mov'd by digestion, decoction, dilution, separation, and mixing.

9^{thly}, With acid fixt salts, of alum, sulphur, vitriol, by decoction, distilling, digesting; or the dry way, by calcining, burning, and distilling.

10^{thly}, With volatile acid salts, by dilution, digestion, distilling, and insinuation.

11^{thly}, With compound salts and soaps, by calcination, subliming, distilling, digestion, the dry or liquid way.

12^{thly}, With metals, by fusion or amalgamation.

Chymical Coagulation.

1st, With water, by congeling, crySTALLISING, precipitation, as in *Mercurius vitæ*.

2^{dly}, With oil, uniting sulphurs, salts, and metals.

3^{dly}, With alcohol in volatile alkaline spirit of salt, in the white of an egg, the serum of the blood, and oil of vitriol.

4^{thly}, With alkaline and acid salts growing solid, as in *Tartarus vitriolatus*.

5^{thly}, With fixt alcali's, as in milk.

6^{thly}, Acid salts, as in milk, serum, and the white of an egg.

Chymical Precipitation.

This action is a manifest separation of the body dissolv'd and disappearing, from the dissolvent, by the mixture of something new. This is of great use, deserves to be accurately consider'd, and has been every where observ'd in the Processes.

1st, 'Tis perform'd by water pour'd on oils dissolv'd in alcohol, with the appearance of milk.

2^{dly}, By water pour'd on resinous bodies in alcohol, with the appearance of milk.

3^{dly}, By water in the distillation of oleous spirits, if in the end the water comes off.

4^{thly}, Of acids by acids. Silver dissolv'd in spirit of nitre is precipitated by spirit of salt, and mercury after the same manner.

5^{thly}, Of metals by metals, &c. Behold here's a glass, in which there's an ounce of silver dissolv'd in spirit of nitre, diluted with 12 times the quantity of rain water, I put thin plates of copper, presently the silver is precipitated, and the copper,

copper dissolv'd. I hold in this glass the copper dissolv'd in spirit of nitre, from whence the silver was precipitated, and I throw little laminæ of this glassy copper, the copper immediately is precipitated, the iron is of a brassy colour, the brass falls to the bottom, and the iron is dissolv'd. Now in this glass I have the iron dissolv'd in spirit of nitre, whence the brass was precipitated, to this I pour in oil of tartar *per deliquium*, the iron falls, the alkali unites itself to the acid, and after all these changes the true nitre appears: Upon these rely precipitation, the true cause of a great many operations both in art and nature. I take a grain of white or red precipitate mercury, this I rub upon a piece of copper finely polish'd and hot; it shines like silver; for the copper by attracting the nitrous acid from the calx of the mercury, makes an amalgam, hence the silver colour.

6thly, Alkali's very often precipitate those things that are dissolv'd by acids, but not always. An alkali precipitates copper dissolv'd by an acid.

7thly, Acids for the most part precipitate bodies dissolv'd in alkali's; but here also is an exception.

8thly, The most acid and hidden salts, by precipitation produce wonderful effects: An ounce of *Luna Cornea*, in which there is no sign of an acrimony, being powder'd and mix'd with half an ounce of regulus of antimony, makes a most virulent butter of antimony: How dangerous therefore is the art of mixing bodies; and what caution is requir'd in their composition?

Chymical Effervescence.

'Tis said to be the sudden commotion arising upon mixing two bodies: This happens various ways;

ways; 1st, Acids, vegetable and native, most juices of plants, trees, unripe fruits, &c. fermented vegetables, *Moselle* and *Rhenish* wines, tartar, vegetables twice fermented, native vinegars and distill'd; (k) acids of animals, in the aliments, chyle, milk, &c. growing sour; of fossils, as that of sulphur, alum, and calcanthum, whether native, or drawn out by a strong fire; or acid, as of nitre, salt, &c. 2^{dly}, True fixt alcali's, made out of vegetables by burning; volatile alcali's, either spontaneous, as in garlick, onions, mustard, &c. or made by putrefaction out of animals or vegetables, or produc'd by distillation and burning. 3^{dly}, Some bodies improperly call'd alcali's, because they effervesce with acids; all boles, shells, corals, horns, chalk, bones, stones, &c. 4^{thly}, The seven metals. 5^{thly}, The semimetals, as bismuth, lapis calaminaris, zinc, &c. Hence, *Canon 1.* Bodies of the first class effervesce with those of the second and third; the effervescence lasts till the saturation, then leaves off; the acrimony after an accurate saturation is mitigated. *Canon 2.* Bodies of the first class effervesce with those of the fourth, but not always alike, and after the saturation they generally become vitriols. *Canon 3.* Bodies of the first class effervesce with those of the fifth, according to the same law. *Canon 4.* Bodies of the 2^d, 3^d, 4th and 5th Class are scarce observ'd to effervesce at all: Hence the strength in acids is to be limited. Spirit of vinegar pour'd on oil of tartar, at first does not grow hot, but when the alcali is made weaker, it heats.

2^{dly}, Pure volatile alcali free from all oil, mix'd with the sincere acid of vinegar, effervesces, but grows cold, when other bodies are hot, and some-

(k) N. B. He owns Acids in Animals, which he had deny'd strenuously in this whole Treatise.

times

times to so high a degree as to flame; hence motion can be augmented with cold: See Part I. p. 376, &c. *Comp. Act. Pb.* Tom. III. 354, 356.

3dly, In most other effervescences heat ensues: See Part I. from page 365 to 379.

4thly, Some bodies raise a flame in a moment. I place in a dry urinal, which is hot, a dram of oil of cloves, to this I pour two drams of *Glauber's* spirit of nitre; immediately there arises a terrible effervescence with smoke and flame; this being done, the matter is brown and spongy: See *Stare's Comp. Act. Pb.* Tom. III. 353 — 365. *Hoffman's Differ. Chem.* 38, 45, and 126. Here the acid and oil meet together, not the alkali and acid; the other effervescences are to be found in *Homberg Ac. R. Sc.* 1701. p. 84, 95. 1708. p. 2.

5thly, Hard bodies also produce an effervescence; as out of iron and sulphur powder'd and made into a paste there arises a flame.

A short recapitulation of Alkali and Acid.

Alkali is either a fixt or volatile salt; 'tis known, 1. From its being produc'd by the help of the fire, putrefaction or nature. 2. From its matter, vegetable, animal, or fossil. 3. From its effervescence with acids; its precipitation; mixing with oils; dissolving sulphur; changing the colours of the sun-flower, roses, violets, into a green, which by acids is turn'd into a red; it may be known by its taste, raising a burning pain.

An acid is a fixt or volatile salt: 1. 'Tis native, fermented or produc'd by the fire. 2. Its matter is vegetable or fossil. 3. It effervesces with alkali's, earths, corals, &c. it precipitates bodies; it turns neutral with alkali's or earth; it dissolves the metallic part of mercury; it changes the colour of the sun-flower, roses, and violets, into a red: In fine, 'tis known by its taste, smell, and

raising pain upon the skin. This doctrine is pretty sure, but not to be carried too far; we must not be content with one physical mark to shew us the presence of an alcali or acid, which is common with others; v. g. an alcali effervesces with spirit of nitre, silver does the same; therefore silver and alcali are the same thing; (1) this does not follow; yet we have seen very ingenious gentlemen draw these consequences, which is certainly a vile error. Gold effervesces with the acid spirit of *aqua regia*, therefore, say they, 'tis an alcali; but it does not effervesce with spirit of nitre, therefore this is no alcali. How vain is it to account for all effects in nature, from an alcali and acid! See *Boyle* and *Bohnius* upon this subject.

The production, destruction, and change of Smells and Tastes.

We have seen these changes from the first to the last Processes: See *Boyle's* treatise of the production of sensible qualities.

The production, destruction, and change of Colours.

1st, Antimony when powder'd is black; after 'tis calcin'd with *aqua regia* 'tis a greenish yellow; when sublim'd with salt armoniac it is white, red, yellow, greenish, and black; 'tis a red, when the water is free from the salt; but is white, when fix'd with a triple quantity of nitre: See here almost all colours from one solid mass. Quick-silver corroded with *aqua fortis*, by distilling gives all colours in various places of the retort, as you have already seen.

2^{dly}, Pouring a very pellucid liquor into a clean vessel we have a most black colour; this is done,

(1) N. B. Silver with respect to those Acids which can dissolve it, is an alcalious Metal.

if we wash any glass vessel with the solution of *vitriolum martis*, and heat it, then pour into it rain water in which galls have been infus'd; in lieu of galls; red roses, tea, sage, or oak leaves, will do the feat.

3dly, By throwing a little white powder into a pellucid liquor I make a black colour: Here is a clear infusion of galls, in this glass, heated; to this I add one grain of vitriol of steel calcin'd white; how pleasant is it to see the pellucid liquor turn black!

4thly, The same is done with a yellow powder; if in place of the white vitriol you take as much of it calcin'd yellow.

5thly, The same may be done with a red powder; if you put in a little colcothar of vitriol of iron calcin'd red, or a little *Ens veneris*.

6thly, We do the same with a pellucid drop, if we drop into the infusion of galls one drop of vitriol of steel dissolv'd in water.

7thly, To do the same with a golden drop, we must pour in a drop of the golden tincture of the red calx of vitriol of steel with mild spirit of salt. In all these experiments, whilst the colour changes into a black, there arises an innumerable sight of colours, which at last terminate into black.

8thly, The black colour made N^o. 2, 3, 4, 5, 6, 7, is chang'd into a pellucid only by transfusing into a clean vessel; 'tis done if you transfuse those black warm liquors into a glass, wash'd with oil of vitriol on the inside, the acid absorbs the metallic part of the iron; mean while those that are made black with *Ens veneris* or colcothar of steel, become somewhat reddish whilst they are becoming pellucid.

9thly, To make this pellucid recover its blackness, pour on so much oil of tartar, and when the effervescence is over the feat is done.

10^{thly}, Pour on to this black, spirit of nitre, and the transparency returns.

11^{thly}, To make a colour by the transfusion of a pellucid liquor into a clean glass; wash the glass with spirit of salt, pour in to this the solution of silver in spirit of nitre; oil of antimony does the same thing.

12^{thly}, To make an orange colour from a pellucid, wash a clean glass with any acid, pour into this water in which *crocus metallorum* was pour'd into hot.

13^{thly}, To make a colour by the affusion of a pellucid to a golden colour'd powder, pour alcohol to *hepar sulphuris* warm.

14^{thly}, To change a golden colour into a milky one, take the tincture N^o. 13, pour it into a glass moisten'd with oil of vitriol.

15^{thly}, To turn a pellucid liquor into a blue, to verdigrease, diluted with vinegar and water pour'd on to it, pour on spirit of salt armoniac.

16^{thly}, To return a blue into a pellucid liquor, put in any acid to N^o. 15.

17^{thly}, To turn a green into a violet colour, to vinegar, which has dissolv'd copper, put in spirit of salt armoniac.

18^{thly}, To turn a blue into a green, to spirit of *sal armoniac* in which copper has been dissolv'd, pour in vinegar.

19^{thly}, To make various greens and blues, to *aqua sapphirina*, made with spirit of salt armoniac, pour in spirit of nitre gradually, and you will see the different changes.

For the rest see Mr. Boyle on colours; I shew'd you some of his experiments. I finish my course, and return you thanks for your patient attendance: I wish these lectures may be for the service of mankind.

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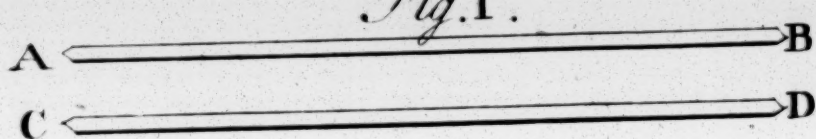
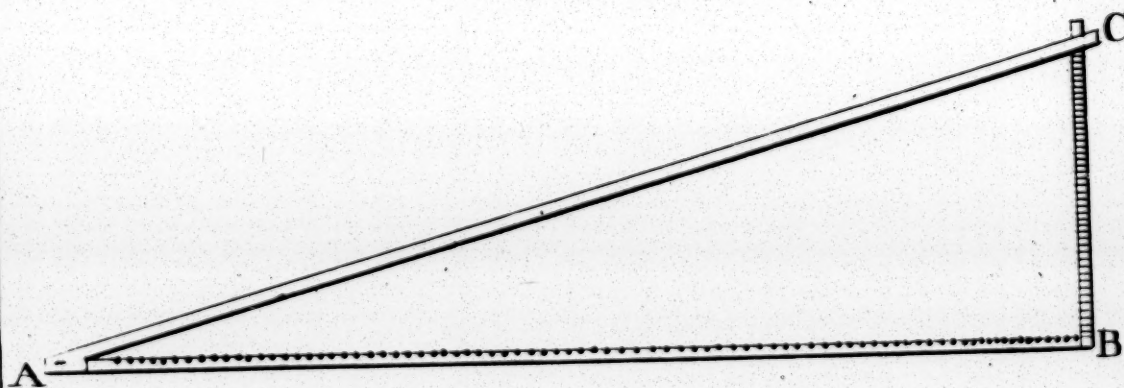
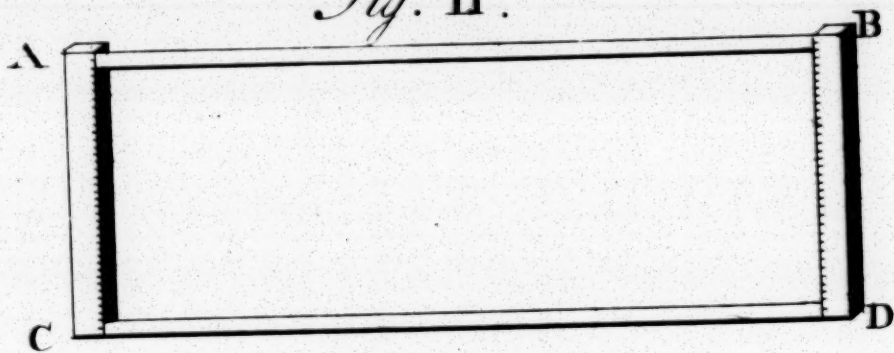


Fig. II.





A N

Explanation of the PLATES.

PLATE I.

FIG. 1.

- AB. CD. *Two cylindrical Rods, three Feet long,
of Iron.*
EF. E. *A Ring with a Handle F. to measure
with.*

FIG. 2.

- AC. BD. *Two parallel Plates, equally divided.*
AB. CD. *Two parallel Plates to move up and
down.*
EF. *An Iron Rod to be measur'd hot and cold.*

FIG. 3.

- AB. *A Brass Plate divided into parts.*
BC. *Another divided, and perpendicular from B.*
AC. *Another fixt in A. moveable on BC. to num-
ber the Degrees.*

P L A T E II.

FIG. 1.

ABCD. Drebbel's *Thermometer*.

A. *Its Globe.*

BD. *Its Neck full of Air to D from A.*

DC. *Its Neck full of ting'd Liquor.*

E. *The Vessel containing the ting'd Liquor.*

FIG. 2.

AB. DC. EF. *Another more sensible.*

ABCD. *Its fore Prospect.*

FIG. 3.

ABCDEF. *The same in Profil.*

Fig. I.

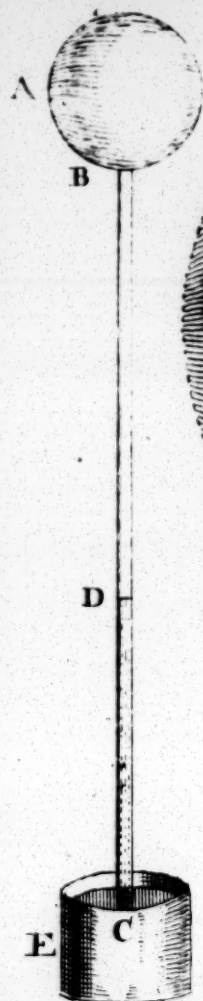
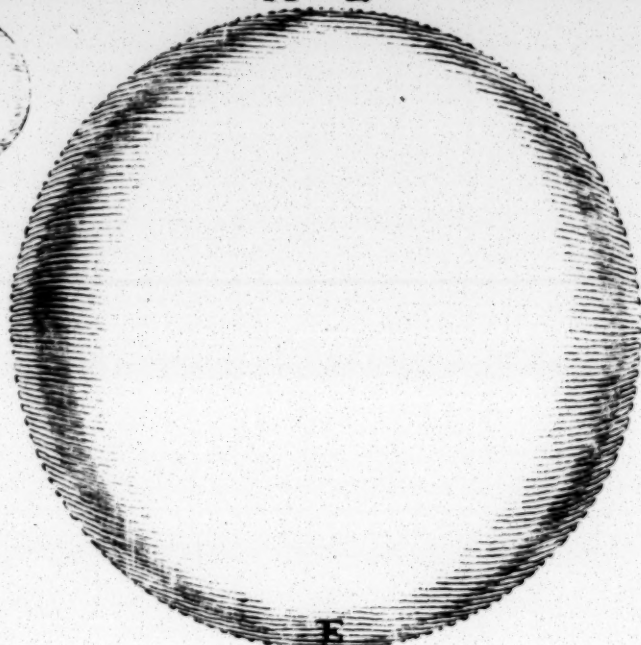


Fig. II

A D

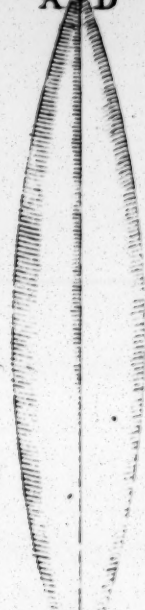


B C



Fig. III.

A D



B C

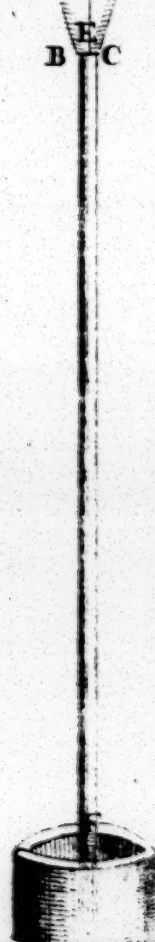


PLATE III.

FIG. 1.

- A. *A small Globe of Fire.*
- B. *A larger.*

FIG. 2.

- AFIG. BDIE. *Two equal Globes touching in I.*
- CD. *A right Line from C touching in D.*
- EE. *Another touching in E.*
- CFG. *A Sector.*

FIG. 3.

- A. *A Globe equal to and touching B.*
- C. *The Centre of A.*
- D. *The same of B.*
- K. *Points of Contact.*
- CKD. *A right Line joining their Centres.*
- EG. *A Parallel to CKD.*
- FI. *A Parallel to EG.*
- EFGI. *A Cylinder to measure the Ratio.*

PLATE IV.

FIG. 1.

ABCD. *A hollow Cylinder.*

BD. *Its opening.*

EFG. *A hollow Cylinder, close at E, open at BD the Grate, and at G.*

FIG. 2.

ABCDEF. *A hollow Parallelopiped, open at ABCD, the Fire in ILKM.*

ILKM. *The Grate.*

EM. *The place for the Smoak, when OGH is hot.*

NO. *The opening, its Length KM.*

NOGH. *The hollow Tube open at NO and H.*

FIG. 3.

ABC. *A Glass open at C.*

AB. *Its Bottom cut open.*

D. *A Brass Cylinder for Liquor.*

EFG. *Tiles to place the Cylinder on.*

FIG. 4.

ABC. *Another Glass Vessel.*

E. *A Pan for Coals.*

D. *A Brass Pan for Spirits.*

FGL. *Files.*

H. *The Flame.*

Fig. I.

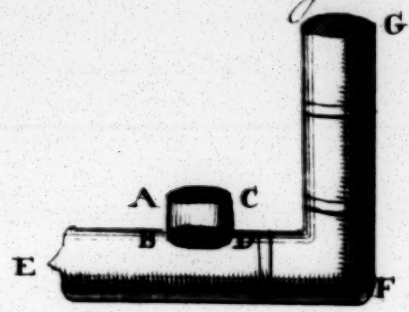


Fig. II.

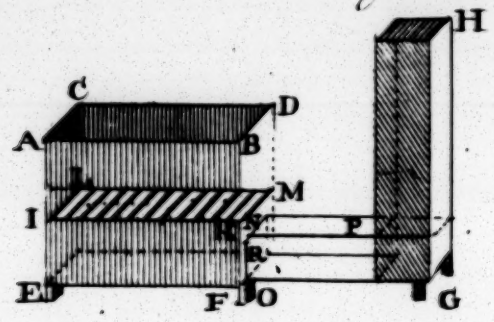


Fig. III.

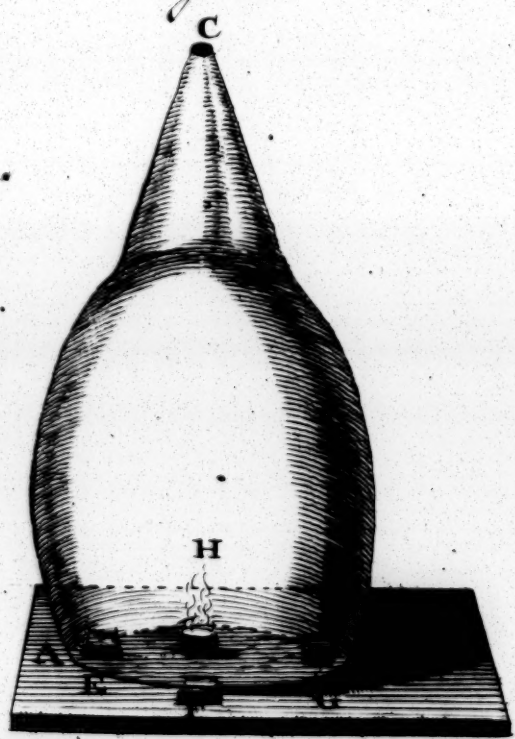


Fig. III.



Fig. I.

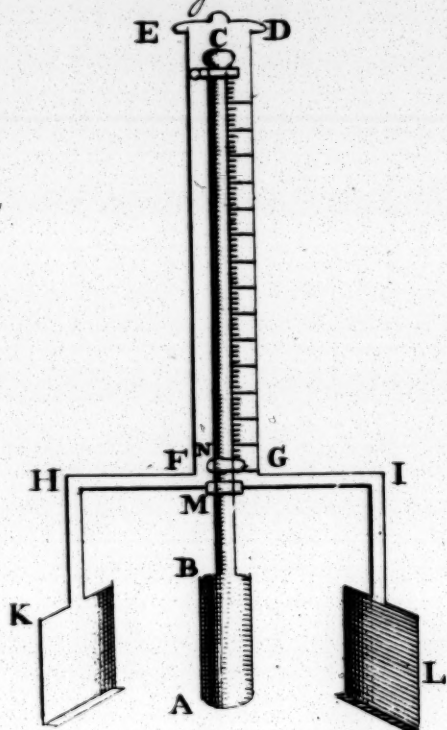


Fig. III.

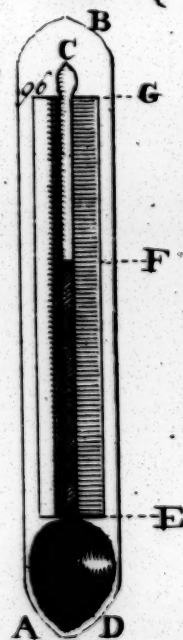


Fig. II.



Fig. III.



PLATE V.

FIG. 1.

ABC. *A Thermometer fasten'd to DEFG by MNO.*

DEFGHIKL. *A wooden Machine to sustain, and to move it.*

PQ. *A Vessel to dip it into.*

FIG. 2.

ABC. *Fahrenheit's Thermometer, with ting'd Spirits and Degrees.*

AB. *The Bulb of it.*

BC. *The Pipe for the motion of the Spirit, &c.*

FIG. 3.

ABC. *Another of Fahrenheit's for Quicksilver.*

AB *The Bulb, from A to B, of 11520 parts.*

BC. *96.*

BC. *The Pipe.*

FIG. 4.

AB. *Another of Fahrenheit's, for human heat.*

AB. *The Tube transparent, seal'd hermetically.*

DC. *Ting'd with Liquor, or fill'd with Quicksilver.*

DE. *The Bulb. EG. The Neck. EF. The Liquor. EFG. A Paper divided into parts.*

P L A T E VI.

FIG. 1.

ABCD. *The Brass Plate to fasten it to.*
EF. *The Glass with Quicksilver.*
GE. *Its Bulb.*
GF. *Its Neck mark'd into 600 parts.*
GH. *Brass Semicircles to fasten it.*
abcd. *A Vessel to dip it into.*

FIG. 2.

A. *A Cylindrical Vessel full open at a.*
D. *A Paper to cover a.*
BB. *A Conical Vessel for the same use.*
C. *A Jug for the same.*

Fig. I.

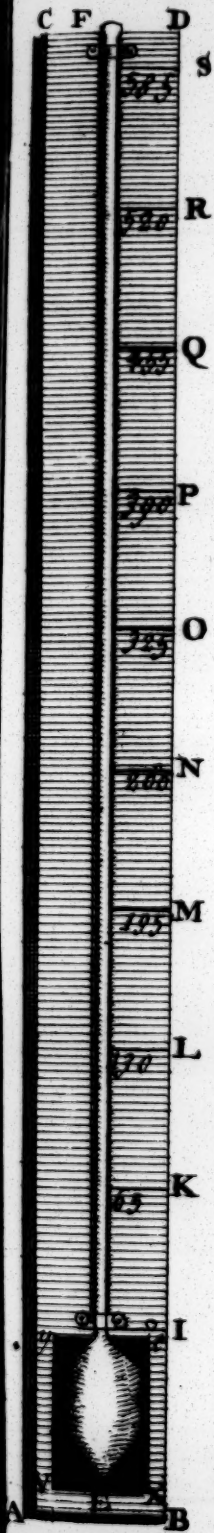
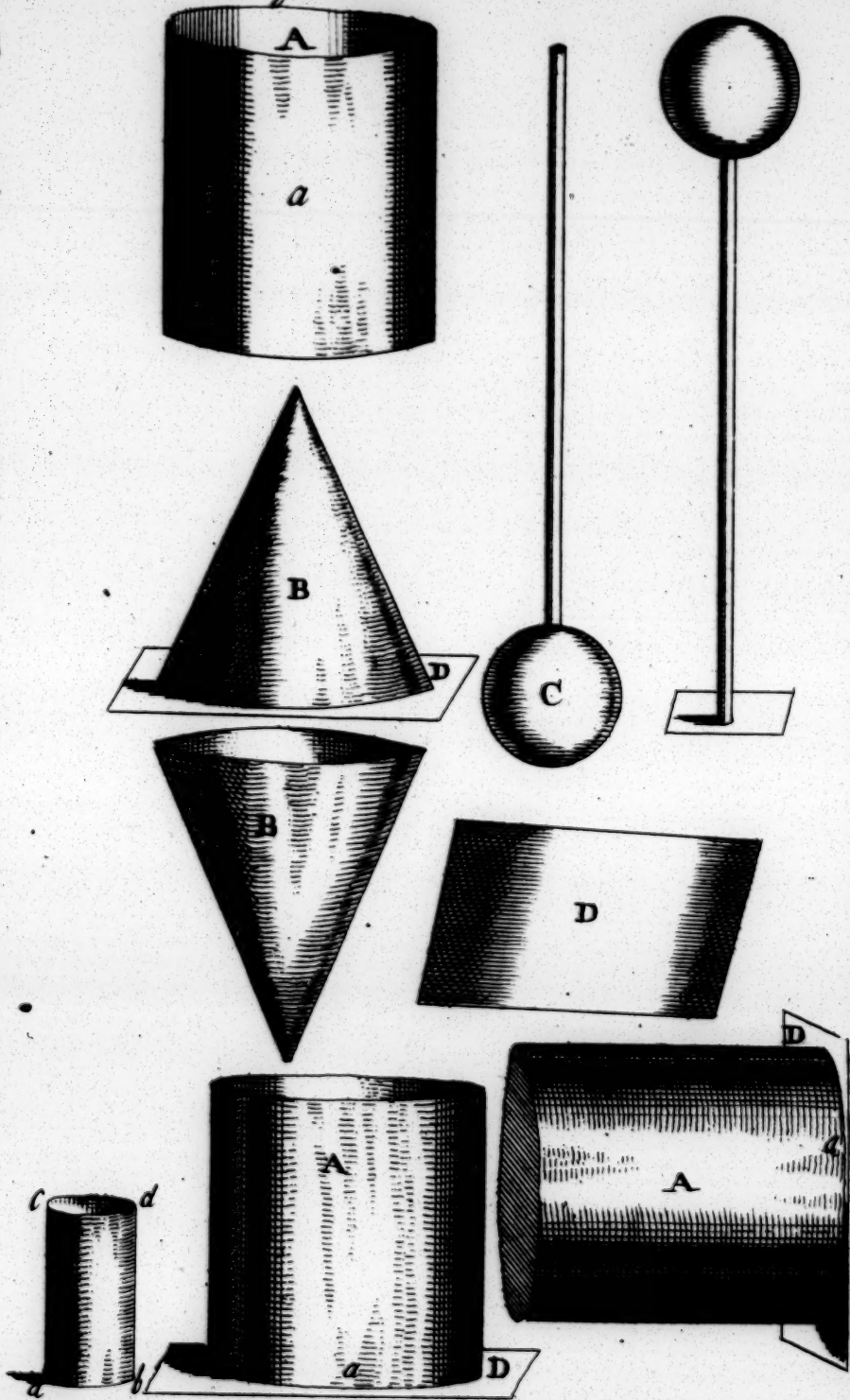


Fig. II.



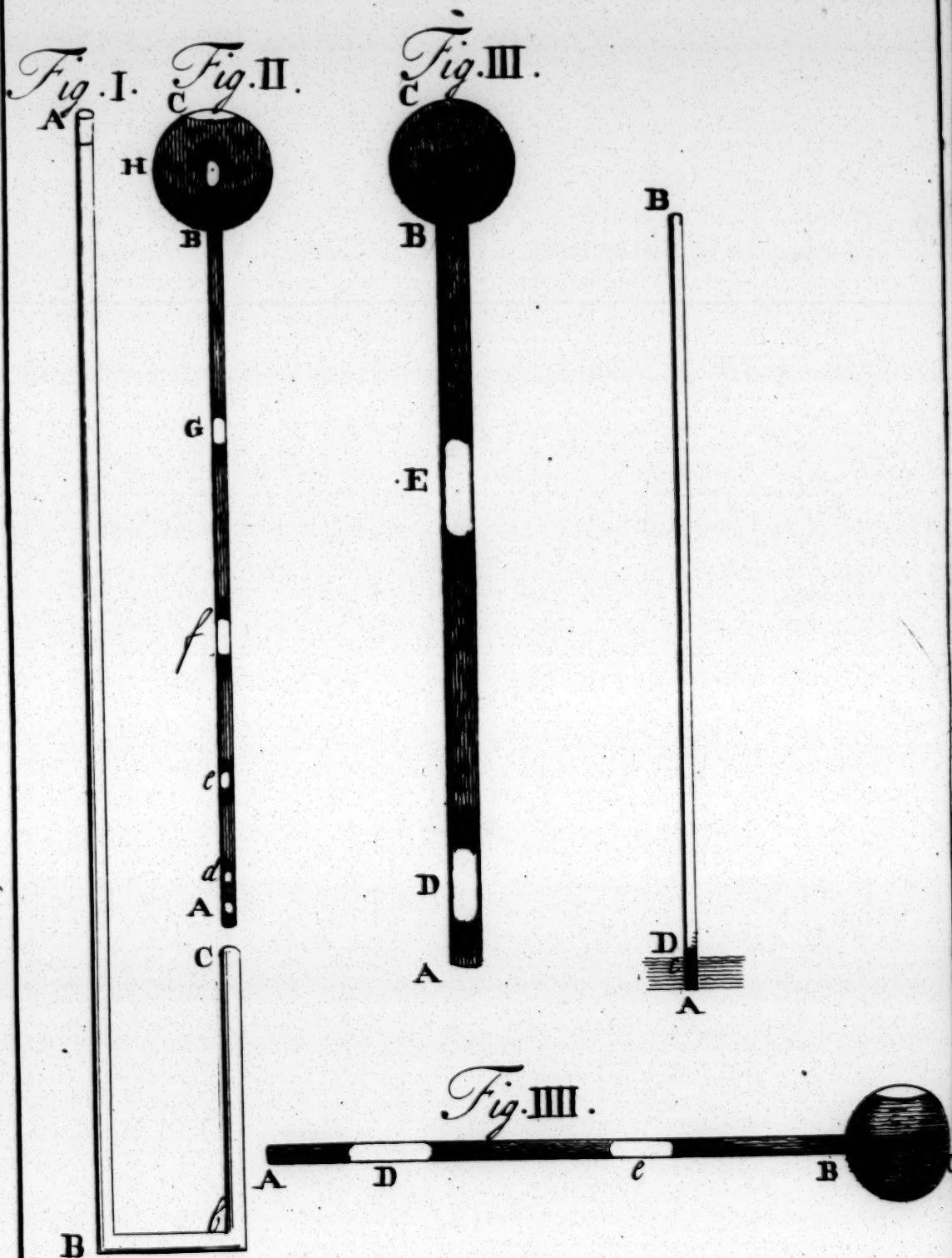


PLATE VII.

FIG. 1.

AB. bc. *A Glass Tube.*
 AB. *The longer Leg.*
 bc. *The lesser Leg.*
 A. *The opening to put in the Quicksilver.*
 C. *The close End.*

FIG. 2.

ABC. *A Vessel inverted full of Water.*
 BC. *Its Bulb.*
 AB. *Its Neck.*
 A. d, e, f, g. *Bubbles.*

FIG. 3.

ABC. *Another full of Water inverted.*
 B.C. *Its Bulb.*
 AB. *Its Neck.*
 d, e. *Airy Bubbles.*

FIG. 4.

ABC. *Another full of Water horizontally plac'd.*
 d, e. *Bubbles.*

FIG. 5.

ABC. *A strait Glass Tube.*
 AC. *Water to put it into.*
 CD. *The Water ascending.*

PLATE VIII.

FIG. 1.

ABC. *Three Glass Vessels with Water heated.*
DEHI. *A Brass Platter fix'd on KL, a Sucker.*
FGMN. *A Bell on DEHI.*

FIG. 2.

AB. *A Glass Cylinder.*
CD. *A Glass Vessel.*

FIG. 3.

AB. *A Brass Cylinder.*
ACD. *A Funnel.*
EFG. *The Vessel full of Water.*

FIG. 4.

AB. *A Copper Vessel, B. Bottom, D. A Cone,*
E. *A Conoid, F. Lying down, G. A Candle.*

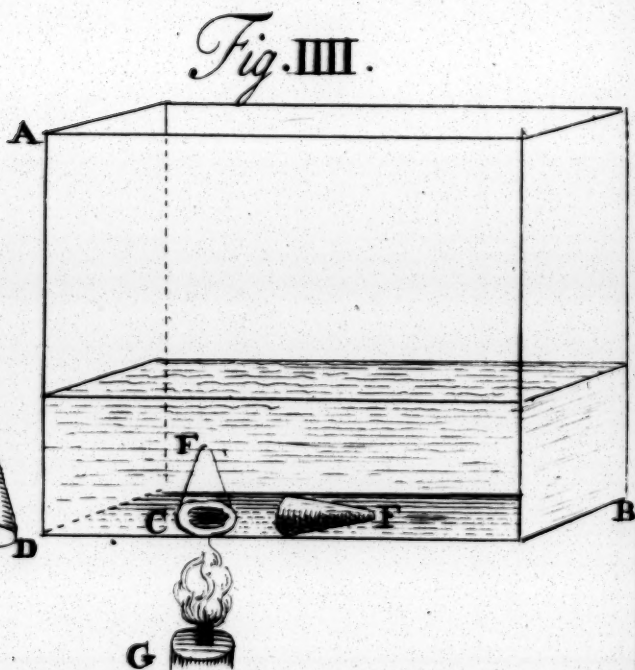
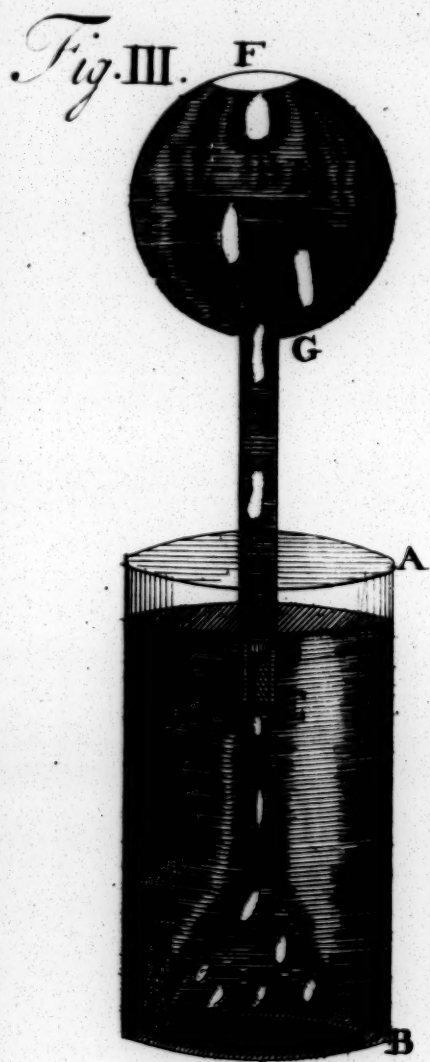
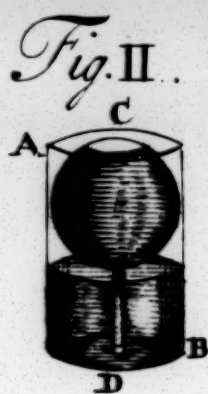
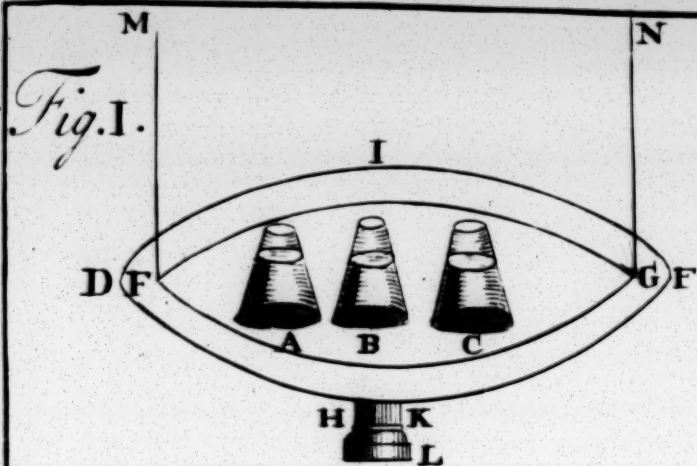


Fig. I.

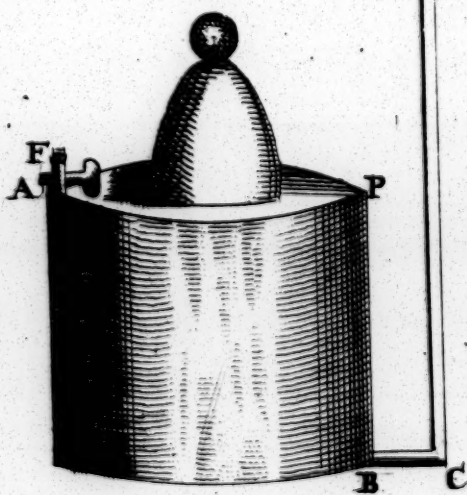


Fig. II.

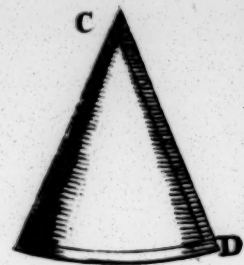
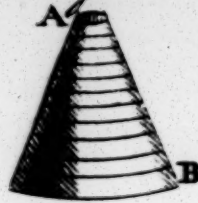


Fig. III.

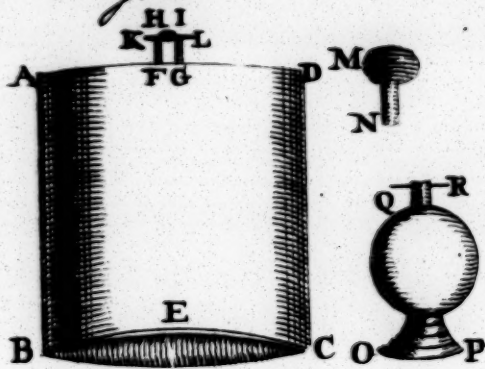


Fig. III.

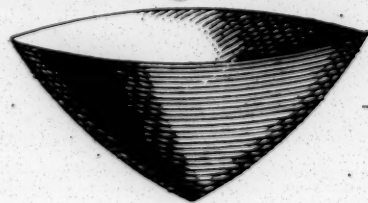


PLATE IX.

FIG. 1.

- AB. *A Brass Cylinder.*
B. *A Tube solder'd.*
AE. *A Cock to turn.*
BCD. *A Brass Tube, open at B, and D, to pour
in any thing by D.*

FIG. 2.

- AB. *An Iron Cone, divided.*
CD. *A wooden Cone to fit AB in a certain degree
of Heat.*

FIG. 3.

- ABCD. *A Cylindrical Glass.*
BCD. *Its Bottom.*
FGHI. *Its Neck, open at HI.*
KL. *A Glass round Margin.*
MN. *A Glass Stopper.*
OPQR. *A Glass Jug for Oils.*

FIG. 4.

- ABC. *Crucibles for bearing Fire.*

P L A T E X.

FIG. 1.

ABCDEF. *A Retort.*

ABCD. *Its Belly.*

AF. *Its Back.*

DE. *Its low part.*

The last of these three is the best.

FIG. 2.

ABCDE. *A Vessel to distill Phosphorus.*

FIG. 3.

ABCDEFGH. *A Vessel to bear the heat of a Furnace.*

IKLM. *A Cylinder to put on to HG,*

ONPQ. *A larger.*

Fig. I.

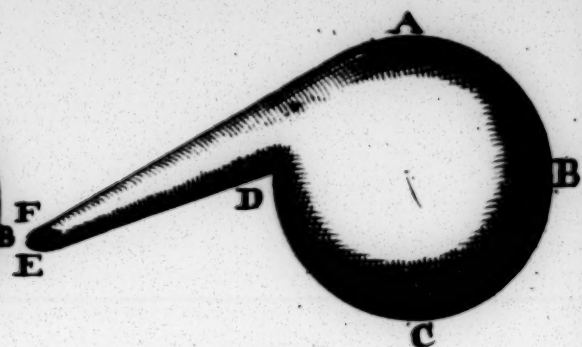
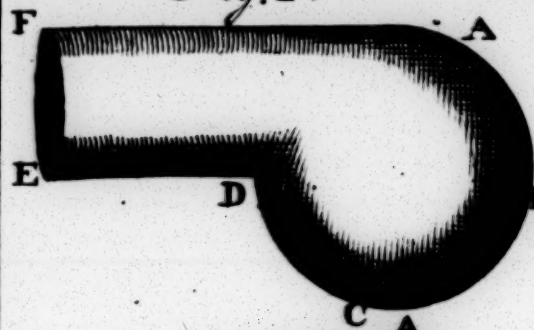


Fig. II.

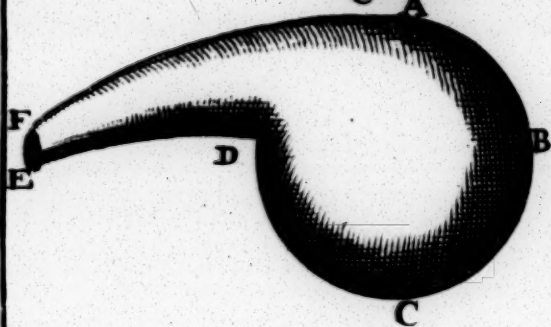


Fig. III.

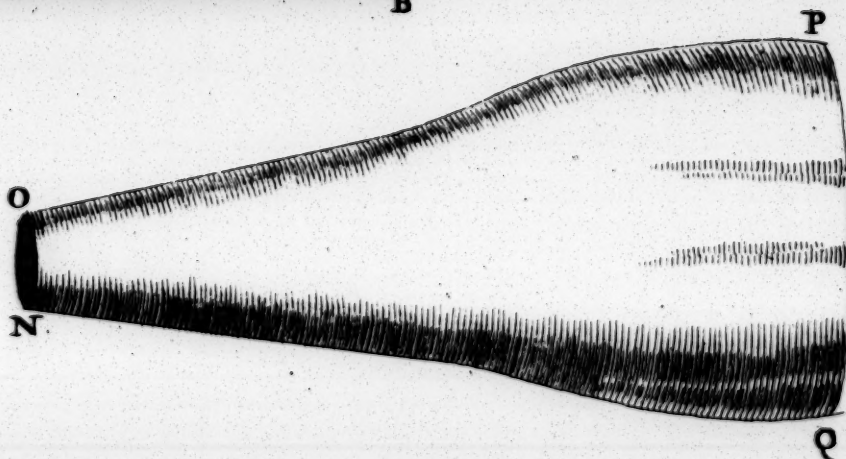
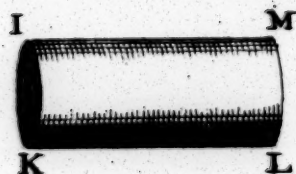


Fig.II.



Fig.I.
E

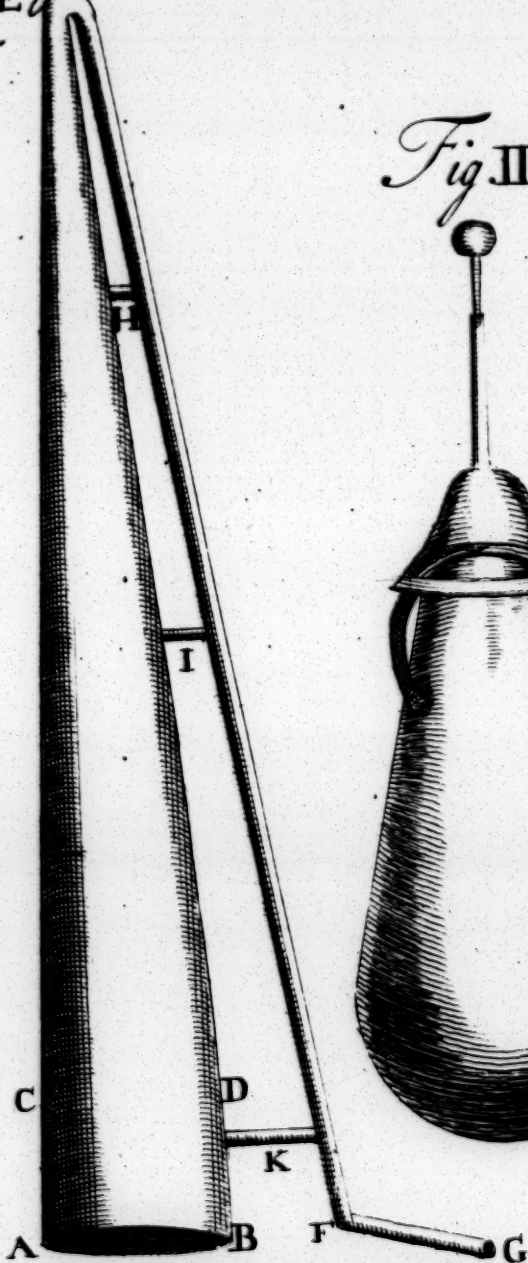


Fig.III.



Fig.III.

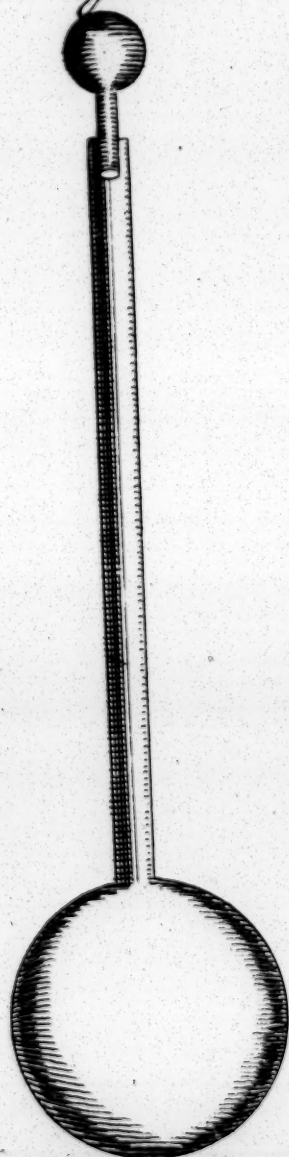


PLATE XI

FIG. 1.

ABCD. *A Tin Cylinder.*

CDE. *Its Height.*

EF. *Its descending Tube.*

FG. *Its Rostrum.*

HIK. *Props.*

This is for making Alcohol.

FIG. 2.

Glass Jugs.

FIG. 3.

Pelican.

FIG. 4.

Another Pelican.

P L A T E XII.

FIG. 1.

A B C D E F G H. *An Earthen Jarr.*

I K L M N. *A Cylindrical Piece to put between the
Jarr and Recipient* **O N P Q.**

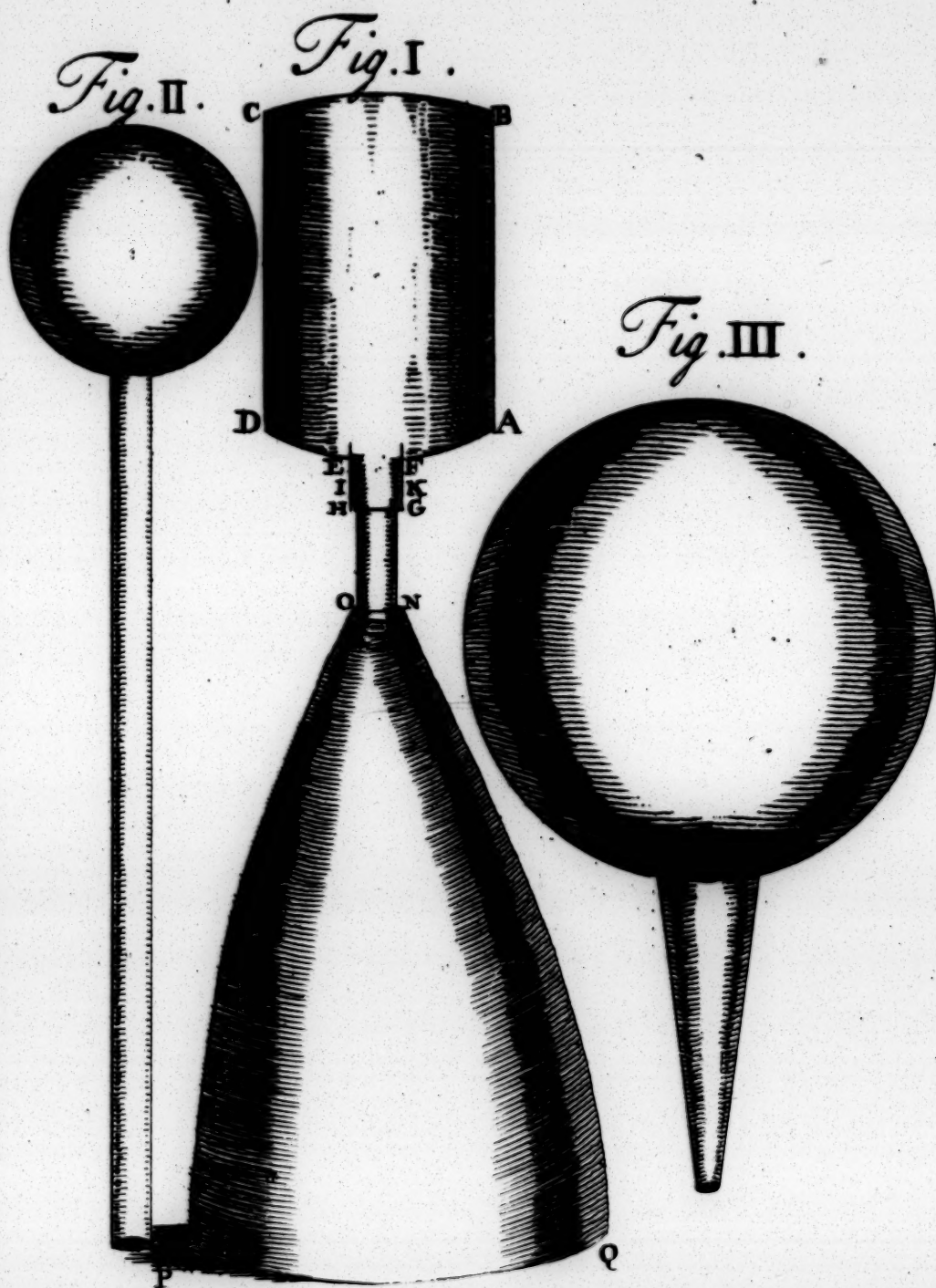
This shews the whole Apparatus for Distillation.

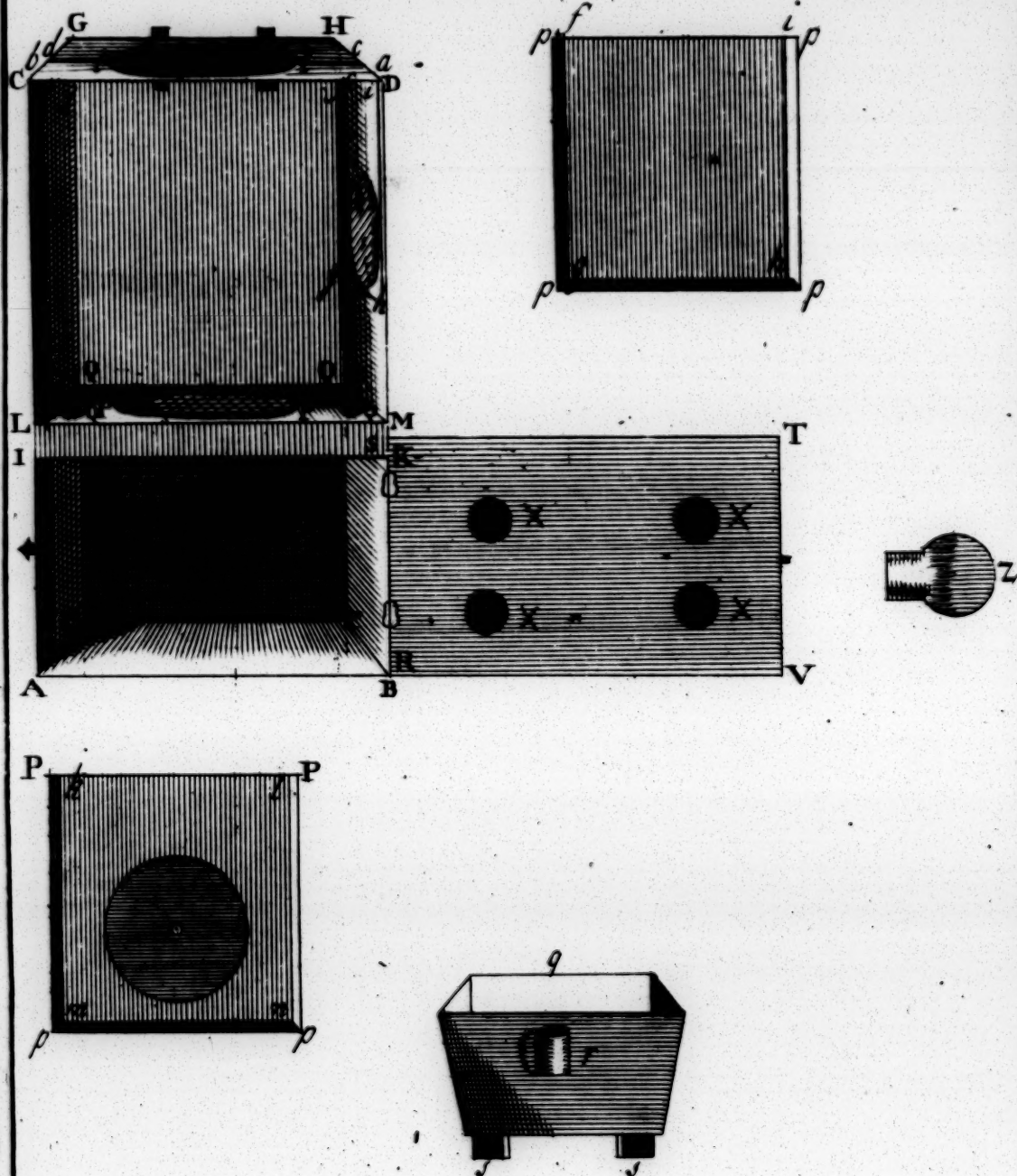
FIG. 2.

A Matraass.

FIG. 3.

A great Recipient.





P L A T E XIII.

The Figure of the first Furnace.

AB. *A nine Inch Bottom.*

ABEF. *The square Bottom.*

ACBD. *Height and Breadth.*

AI. BK. *Its Height 5 Inches.*

IL. KM. *The thickness of the Septum 1 Inch.*

LC. MD. *Its upper part's Altitude.*

PP. *A round hole for the Cucurbit.*

fghi. *A square hole, for putting in a square Plate.*

QQQC. *Four square holes for Chimneys.*

fp. gp. kp. ip. *A Magin cut out for a Cucurbite.*

klmn. *Another square Plate with a round hole
o for a Retort.*

fg. km. *Six Inches two 5ths.*

RSTU. *The Door to open or shut.*

XXXX. *Four round holes in the Door for Air.*

Z. *Wooden Stoppers.*

Cb. Da. Gd. Hc. *Two turning Valves.*

q. *An Earthen Vessel.*

r. *Its Handle.*

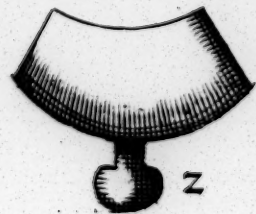
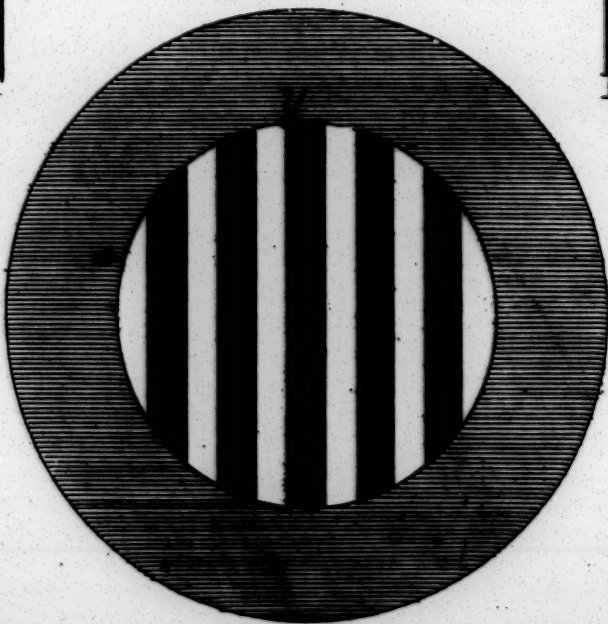
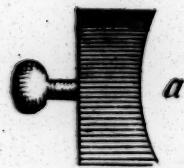
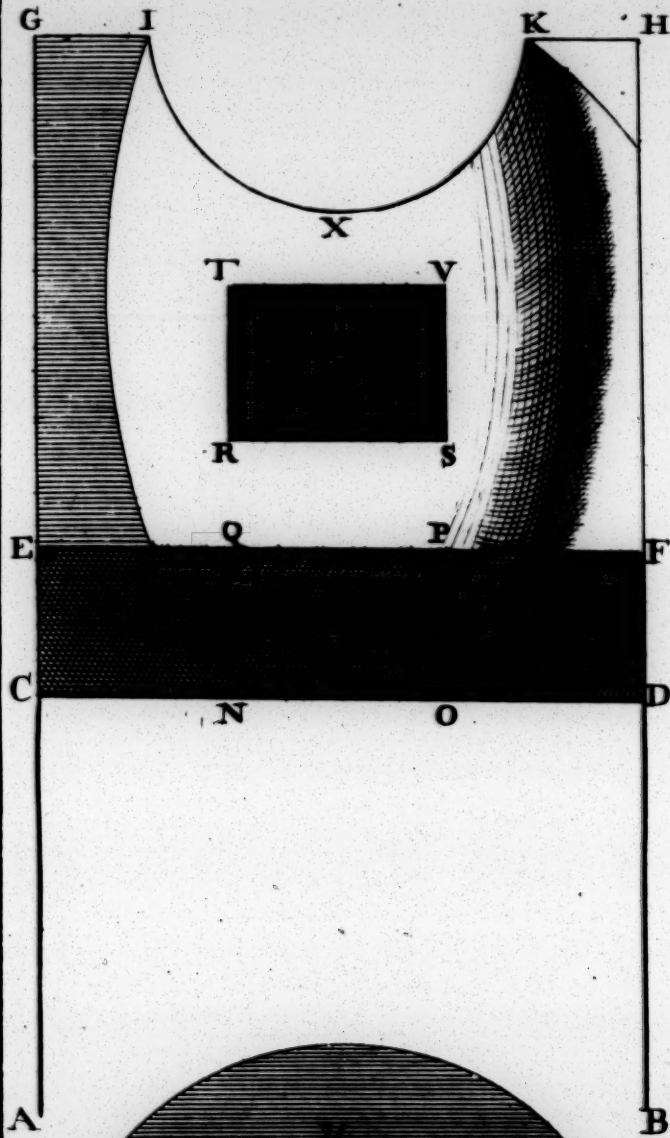
fs. *Its Feet.*

PLATE

PLATE XIV.

Second Furnace.

- AC. BD. *Iron Feet 12 Inches long.*
 CNOD. *Its Bottom 17 Inches over, of Iron or
 Brass.*
 CG. HD. *A hollow Cylinder 19 Inches high.*
 ELMF. *An Iron round Grate, supported by EF.*
 EL. MF. *Its Breadth 3 Inches and an half.*
 EC. DF. *The distance of the Grate from the Bot-
 tom 4 Inches.*
 NOQP. *The moveable Door of the Ash-hole.*
 QRPS. *The distance of the Door of the Fire-place
 from the Grate 3 Inches.*
 RSTU. *The Doors open 6 Inches, high 4 Inches
 and an half.*
 ILKM. *Elliptical Fire-place.*
 a. *A Stopper of the Door.*
 Z. *The same in another view.*
 KHX. *An open for the Retort.*
 IKX. *A Pot 10 Inches broad and 5 deep.*



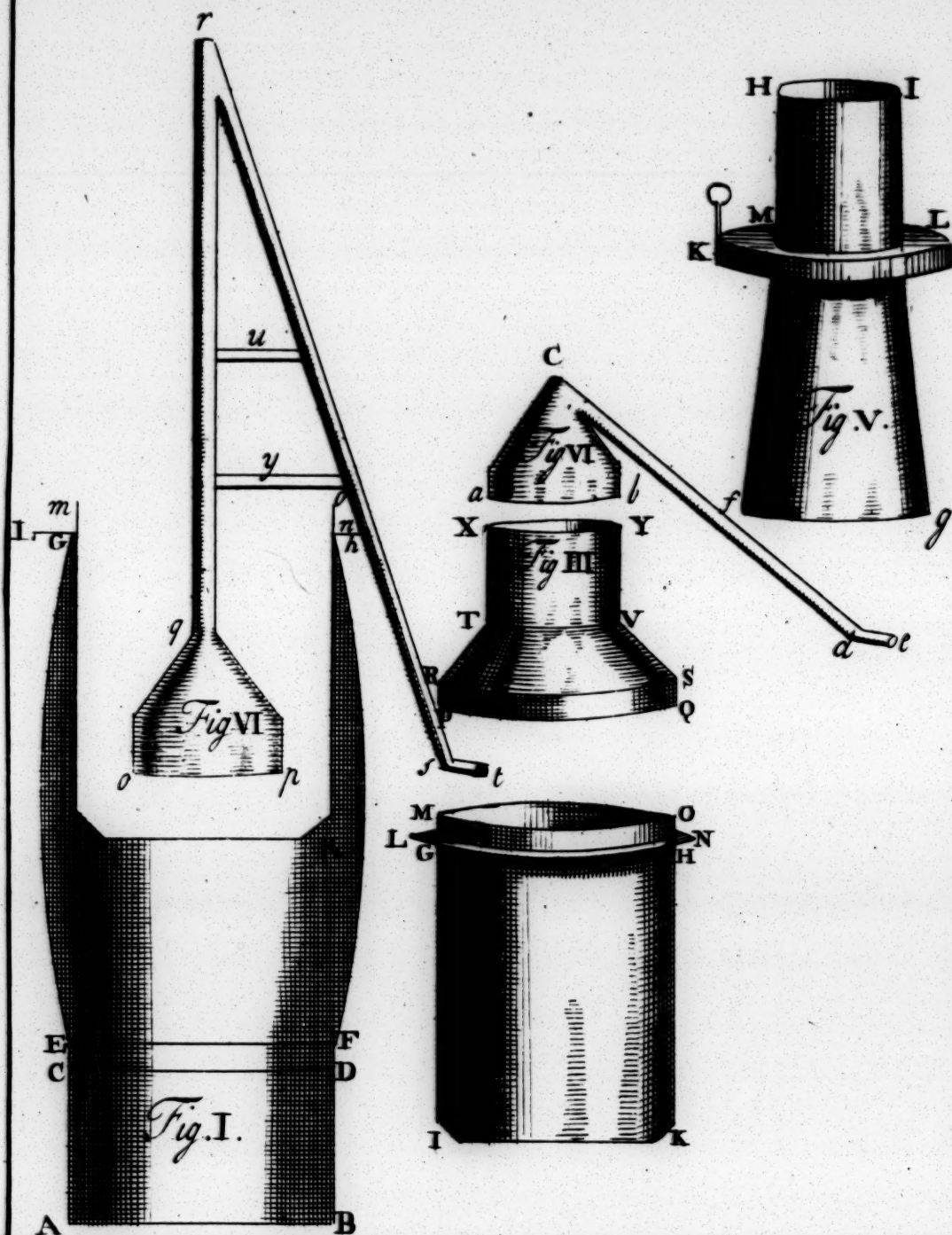


PLATE XV.

FIG. 1.

The Structure of a Furnace.

- AB. *Asb-hole* 10 Inches broad.
 AC. ——— 6 Inches high.
 EC. *Grate* 1 Inch thick.
 EI. *Height from the Grate* 8 Inches.
 IG. *The Vessel* 12 Inches high.
 LG. *The Margin* 1 Inch.
 GM. *The other Margin.*
 EGHF. *Cavity of the Furnace Elliptico-conoid,*
distance of Focus's 20 Inches, *Normal in the Fo-*
cus 5 Inches.

FIG. 2.

A Vessel for distillation.

FIG. 3.

- A Brass Cover.*
 RS. *Handles to place it on.*
 RT. SV. *Its Middle.*
 TX. VY. *Its Neck.*

FIG. 4.

An Alembick.

FIG. 5.

A Vessel to distill with in Balneo Mariæ.

FIG. 6.

A Tin Alembick.

P L A T E XVI.

A Smelting Furnace.

abcd. *A Stone hollow Base.*

cdef. *Asb-hole.*

efih. *Grate.*

ab. cd. ef. hi. *Breadth 12 Inches.*

hk. il. *Fire-place 6 Inches high.*

k m n l i. *A Paraboloeid Cone, whose Axis is 8 Inches,
and Ordinate 6 Inches.*

m n o p. *A Cylindrical Chimney.*

a u y q b x z s. *The thickness of the Stone 5 Inches.*

P L A T E

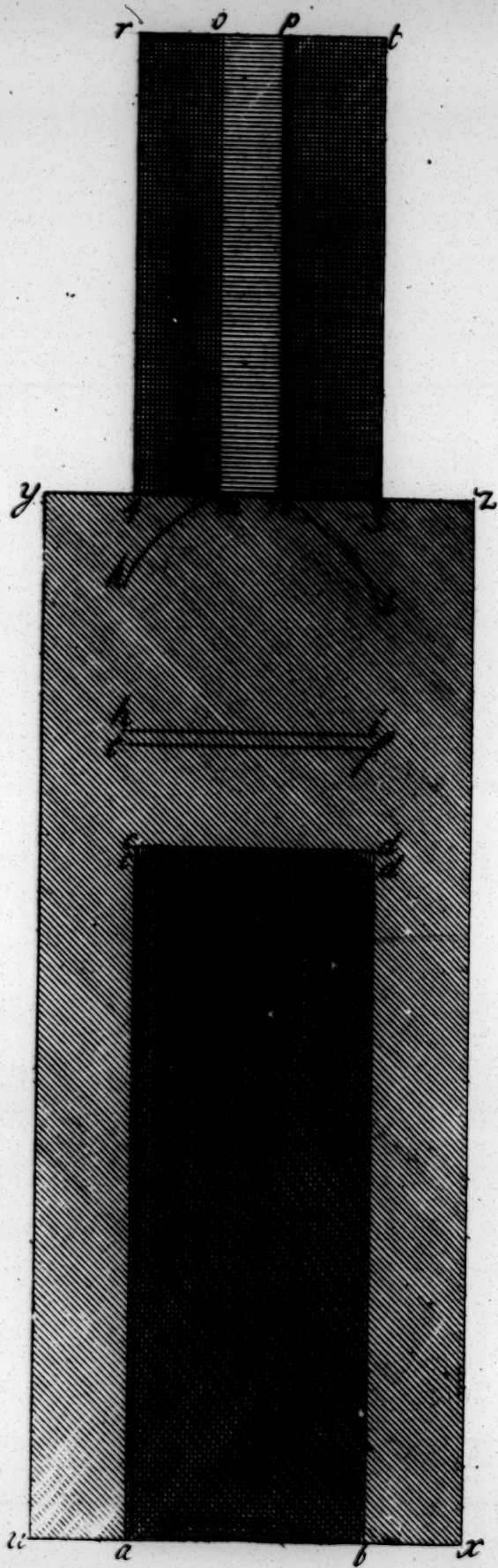


Fig. I.

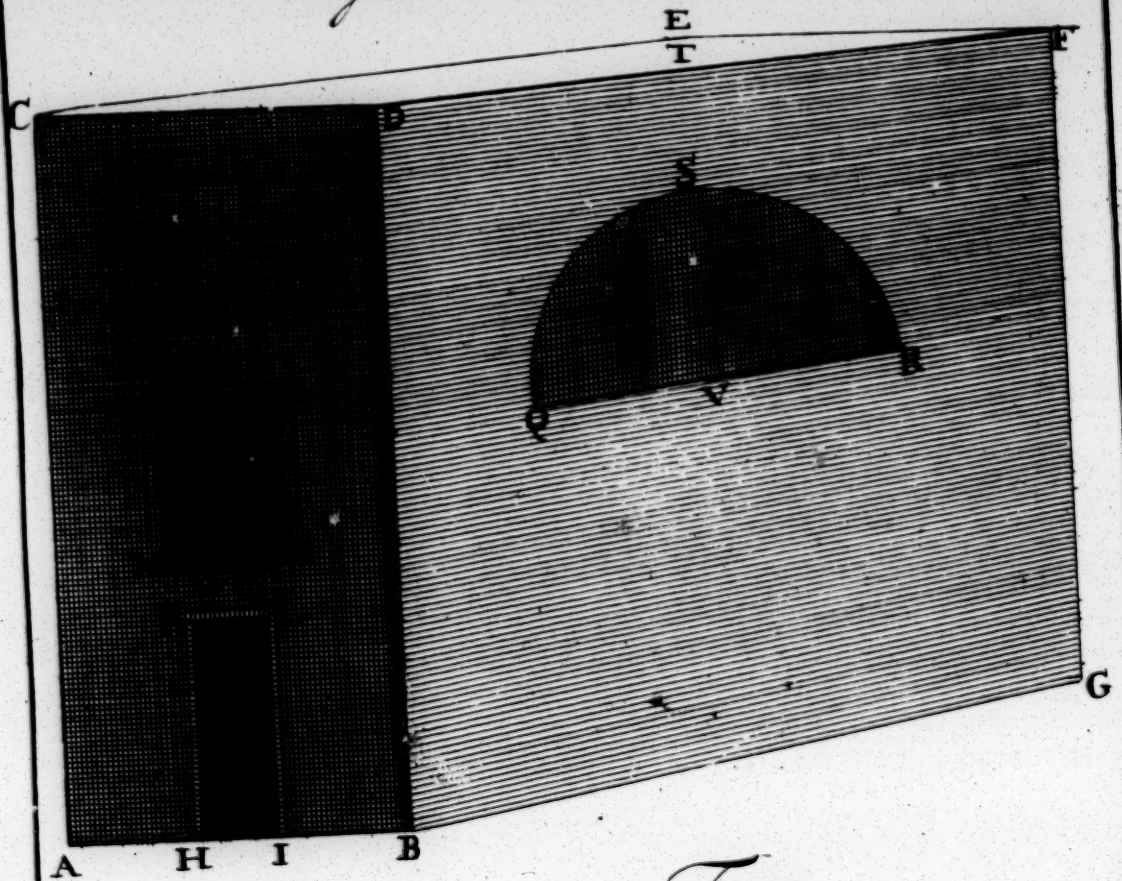
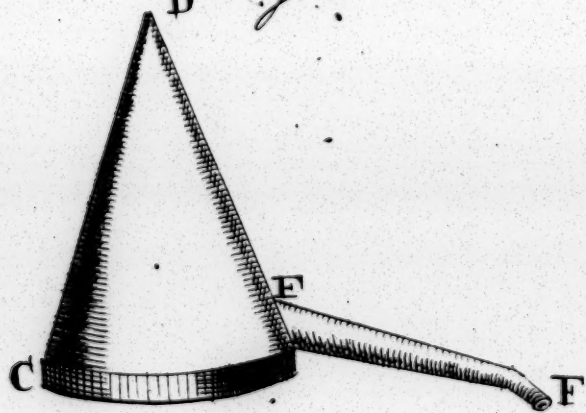
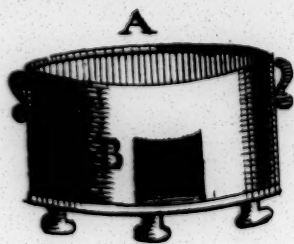


Fig. II.



P L A T E XVII.

Fifth Furnace.

FIG. 1.

- AB. *The Furnace 20 Inches broad.*
AH. IB. *Length 8 Inches.*
III. *Asb-hole 11 Inches high.*
KM. LN. *Distance of the Door from the Asb-hole 3 Inches.*
MN. OP. — *Breadth 9 Inches.*
BG. DF. *Furnaces Length 38 Inches.*
QRS. *Place for the Vessels.*
QS. *Length 20 Inches. VS. Height 12 Inches.*
SF. *Thickness of the Wall 6 Inches.*

FIG. 2.

- AB. *A Furnace of Brass for the first Process,*
Tom. II.
CDEF. *A Tin Alembick to fit AB.*

P R E A T A.

T. 1. p. 179. for *77*, read *177*. T. 2. p. 110. l. 7. for *drugs*, read *drugs*. Process 214. p. 192. after *this emetic*, read *it is call'd golden, because if rubb'd on Silver, it gilds it.*

